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THE TELEPHONE.

IT appears very probable that when the true history of the telephone is written it will reveal as many curious facts as has been the case regarding the invention of the electric telegraph. Mr. Fahie has recently upset, in his history of the latter invention, all our old-fashioned and cherished ideas as to who invented the telegraph.

Cooke and Wheatstone will no longer occupy the same place in our traditions as they did previously to the publication of Mr. Fahie's admirable compilation. It has taken many years to disabuse our minds of the notions formed from long, long ago, but we must learn sooner or later the true facts concerning all inventions which are of public utility.

The true history of the invention of dynamo-electric machines is now almost universally known, and the man who was, scarcely more than ten years since, looked upon as the originator of the dynamo is now only considered as having effected a useful improvement in that which was virtually a practical invention years before. The evolution of the facts relating to telephony is gradually progressing, and Prof. Graham Bell must now stand in the same category in relation to the telephone as Cooke and Wheatstone do to the telegraph and M. Gramme to the invention of dynamo-electric machines.

We publish this week some of the most remarkable circumstances connected with telephony that have ever appeared, not excepting those with which the recent publication of the life and labours of Reis have made us acquainted. Indeed the inventions of Daniel Drawbaugh are apparently of as practical a nature as those in daily use at the present moment.

The evidence in favour of Drawbaugh is overwhelming, nearly two hundred witnesses testifying to the validity of his claims.

In America, therefore, there seems to be no reason to doubt that the complete collapse of the Bell patents is close at hand. It remains to be seen whether any proof exists in England of the invention and publication of a practical method of telephony previous to the specification of Bell. With this matter, however, we have at present nothing to do, for if such be the case it must eventually become known. One great fact still remains—Bell made the telephone what Cooke and Wheatstone and Gramme, respectively, made the electric telegraph and the dynamo—a commercial success.

The world at large is probably more indebted to the men who take up, and bring, more or less crude inventions into practical operation, than to the inventors themselves. Notwithstanding that appearances may be against it, we venture to believe that Bell, although clearly forestalled in his long and arduous labours, was not aware of what had been previously accomplished, and that he is, therefore, truly an inventor, and not a mere adapter.

If our surmise be a correct one, then nothing should diminish the regard with which Prof. Bell has hitherto been upheld, nor take away one tittle from the merits of his work and the results which have arisen therefrom. With respect to Daniel Drawbaugh, we think that our readers will be of one accord with us in our expressions of surprise and admiration at his marvellous ingenuity.

DIRECT-READING ELECTRIC MEASURING INSTRUMENTS.*

By Professors W. E. AYRTON, F.R.S., and JOHN PERRY, M.E.

THE construction and use of our various measuring instruments are now sufficiently well known that it is unnecessary for us to give any general description of them; indeed, the names "Ammeter," "Voltmeter," by which we ventured to christen two of our children, have found favour in the eyes of electricians, and are now current in electrical literature as the typical names, or surnames, of instruments used to measure strong currents and large electromotive forces respectively. But just as improvements in electrical measurements have led, step by step, to the names for the electrical units receiving more and more exact definitions, so we now propose to take advantage of certain important improvements that we have recently effected in our measuring instruments to define the names "Ammeter," Voltmeter," and "Ohmmeter" more exactly.

Proportional Law.—In the earliest form of instruments commercially employed for measuring the large currents used for electric lighting, viz., the instruments of M. Deprez, reference had to be made to a table of values to ascertain the meaning of any particular deflection, since there was no immediate connection between one degree deflection and one ampère; and, further, it was necessary to refer to the table twice over when measuring two different currents, as the deflections were not proportional to the current. By giving a proper shape, however, to the coil, needle, and to the pole pieces of the controlling permanent magnet, we succeeded, in 1880, in producing instruments in which the current, or potential difference, was exactly proportional to the deflection throughout the whole range of the scale; and, further, by the employment of our commutator principle, an instrument was obtained having two degrees of sensibility, one exactly ten times the other, so that a commutator-ammeter or voltmeter, although employed to measure strong electric currents and large potential differences, could be calibrated by the employment of a single cell of known electromotive force, but of totally unknown resistance.

Objections to the Employment of a Constant.—But these instruments possessed one serious fault, looked at from the users' point of view, and two others which especially concerned the manufacturer. The scales of all the instruments were divided into degrees, and although the deflections were proportional respectively to the current or to the potential difference to be measured, still there was nothing to show to how many ampères or volts one degree of the scale corresponded. Consequently for each instrument there was a "calibration constant," such as 1·75 ampères, or 2·14 volts per degree, which was determined experimentally by the makers. We have here two of this old type of voltmeter, in one of which 5·7 volts produces one degree deflection, and in the other 0·09 volts produces one degree, the former being intended for measuring electromotive forces up to about 230 volts, the other the electromotive force of a single cell. But the employment of such a constant had the very serious objection that, as all the instruments looked exactly alike, there was the great danger in any factory where several of these instruments were in use of the constant for one instrument being used accidentally for that of another. And this mistake not only rendered the answer, of course, quite wrong, but was liable to lead to the destruction of the instrument, or, at any rate, to the breaking of the pointer, from say an instrument having a constant 0·12 ampères per degree being put on a circuit through which 50 ampères were flowing, in consequence of the experimenter mistaking the constant for 1·2 ampères per degree. Further, even if no mistake be made in the constant, it is troublesome, except for those who are expert in mental calculation (a quality not always predominating in the men in charge of electric light circuits), to multiply a constant 3·17 by the deflection, say 21·32, quickly, without the employment of paper and pencil.

We therefore decided, not merely to avoid using tables of values, such as had to be employed by M. Deprez, but even to abandon the use of constants altogether, and to arrange matters so that the pointer pointed at once throughout the whole range of

* Read at the Physical Society of London, January 26th.

the scale, to the number of ampères or volts to be measured—to design, in fact, "direct-reading" instruments, and for the future we propose to confine the definition of an "ammeter," a "voltmeter," and an "ohmmeter" to instruments in which respectively ampères, volts, and ohms respectively can be *immediately* read off without any calculation or any reference to a constant, or to table of values.

On the table there are various specimens of our new direct-reading ammeters and voltmeters. In each case the the dial is a complete disc (see fig. 1) and not a sector, as in old instruments. The light aluminium pointer is also much longer, and the length of the graduated arc over which its end moves is also much greater, so that readings with the new instruments can be made much more accurately than with the old. Here is a direct-reading ammeter suitable for measuring up to ten ampères, correct to a tenth of an ampère; here another for measuring up to 150 ampères, each division of the scale corresponding with one ampère. I now send a currant with these accumulators through this thick German silver wire, and you see at once, from the deflection on this other ammeter, without any reference to a table of values, and without the employment of any troublesome constant, that the current passing, and which is now making the wire white-hot, is 207 ampères. Again, each division on the scale of this voltmeter corresponds

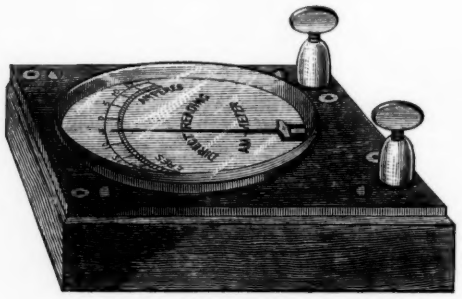


FIG. 1.

"DIRECT-READING NON COMMUTATOR INSTRUMENT."

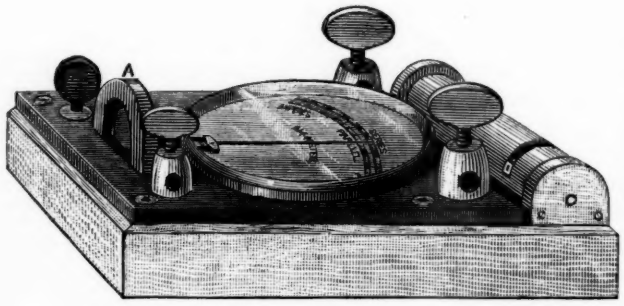


FIG. 2.

"DIRECT-READING COMMUTATOR INSTRUMENT."

with one volt, this particular instrument being suitable for measurements up to 100 volts.

To construct a direct reading instrument, it is necessary to employ some form of adjustment for sensibility, since, to have a special scale engraved for each instrument after it was wound would be both troublesome and expensive; and further, if there were no power of adjustment, any change in the strength of the permanent controlling magnet would prevent the instrument any longer giving one division deflection per ampère or per volt: in other words, would then necessitate the employment of a constant.

Difficulties of Manufacture of Older Forms.—As regards the two defects, from the manufacturers' point of view, they were these:—Even although the shape of the coil, needle, and pole pieces of the magnets were made accurately to templates, it was found difficult when very thick wire had to be coiled on the bobbin of an instrument for measuring strong currents, to wind it with certainty so that both the deflection was proportional to the current, and so that equal deflection on the two sides of the zero had exactly the same value. As long as the wire was thin, symmetry of winding was comparatively easy to obtain; but when thick wires, having but a few convolutions, were wound round a small bobbin, the thickness of the wire, combined with the galvometric importance of each of the few convolutions, especially of those closest to the needle, made it necessary to wind and rewind some of the instruments several times before the proportional law, as well as equal deflections right and left, could be obtained.

Adjustment of Direct Reading Instrument.—It therefore was important, to avoid complexity of construction, that the adjustment for sensibility referred to above should, if possible, be so contrived as to serve also for an adjustment for the proportional law. And this, we are happy to say, we have at last succeeded in accomplishing by fitting into each end of the bobbin, round which the wire is wound, specially constructed charcoal iron cores fitted with a fine screw. If these cores be too far out, or out altogether, the proportional law will probably not be true, the current increasing more rapidly than the deflection. On the other hand, if they be screwed fully home the proportional law will also not be true, the deflection now increasing more rapidly than the current; but we find that between two limiting positions of these iron cores the proportional law is true, and by moving the cores in or out within these limits the sensibility of the instrument can be much altered without destroying the proportional law.

To construct then, say, a 50 ampère instrument, wire is selected of such thickness:—first, that 50 ampères will not heat it too much; secondly, that a sufficient number of convolutions can be wound on the bobbin for 50 ampères to deflect the needle to the limit of the scale when it is controlled by a permanent magnet of normal power. A scale, divided for 50 ampères, that is, having the division marked 50 ampères at the end of its range, is then put on, and the soft iron cores screwed in or out a little by trial until the pointer points to exactly the same number on the dial as the number of ampères of current flowing through the coil. If at any future time it be found that the permanent magnet has lost some of its magnetism, so that less than, say, 40 ampères will deflect the pointer to the 40 ampère mark on the dial, the iron cores are unscrewed out a very small distance until the change in the magnetism of the controlling magnet is exactly compensated for.

The other adjustment to be employed by the makers for equalising the deflections right and left for the same current, is effected by fixing the coil so that it can turn about its centre.

The "Ten Law" of our commutator instruments, which means that an ammeter is exactly ten times as sensitive when the commutator is turned to series as when to parallel, while a voltmeter is ten times as sensitive when the commutator is turned to parallel as when turned to series, is effected by the ten wires forming the bobbin having, inclusive of the resistance of the contacts at their ends, exactly the same resistance; which condition being fulfilled, it is quite unnecessary to obtaining the ten law that the ten wires composing the strand should be at all symmetrical in the way in which they are wound on the bobbin. With some of our earlier commutator instruments, the resistance of the contact of the springs with the metallic pieces of the commutator introduced an error when the ten wires were each thick and short, since then the terminal resistance was a very material portion of the whole resistance of any one of the ten wires. To avoid this, the commutator and the springs, as will be seen from the various specimens of the instruments on the table, which, Darwinian like, show the history of the survival of the fittest have assumed a much larger form.

In our direct-reading commutator instrument the scale is double, as may be seen from figure 2, the upper numbers corresponding with the number of ampères or volts when the commutator is series, the lower when to parallel.

Fig. 3 shows the interior of the latest form. A, A, is the bobbin

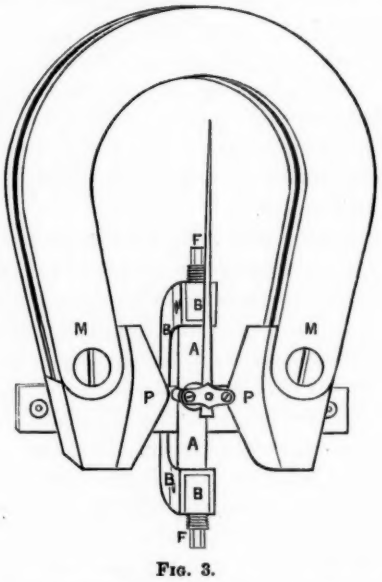


FIG. 3.

"INTERIOR OF DIRECT-READING INSTRUMENT—LATER FORM."

round which the wire is coiled. M, M, is the permanent controlling magnet, made in two parts to obtain considerable strength. P, P, are the soft iron pole pieces, of special shape, to be referred to further on. F, F, are the soft iron cores, and B, B, is a connecting bridge piece of charcoal iron used in our latest form of instrument for

increasing the strength of the deflecting field for a given current, by connecting magnetically these iron cores together. This addition is very important in voltmeters, since, although in an ammeter the constancy of the instrument is nearly independent of temperature, this is not the case in a voltmeter. The current producing a given deflection in either instrument is practically independent of temperature, but the potential difference necessary to be maintained at the terminals of the instrument to produce the current, and which potential difference is what the voltmeter is designed to measure, depends necessarily on the resistance, and therefore on the temperature of the coil. A temperature correction can be easily made for the portion of the effect arising from the temperature of the room; but the unknown amount of heating of the coil arising from the passage of the current it is far more difficult to allow for. Hence, it is generally necessary to be contented with a weaker controlling permanent magnet for a voltmeter, in order that the magnetic effect necessary to produce any given deflection, and consequently the heating effect, which is proportional to the square of this magnetic effect, shall be less in the case of a voltmeter than in an ammeter. But the employment of our soft iron pole pieces, combined with the soft iron bridge, enables us to use much more powerful controlling magnets, and therefore to obtain a much greater deadbeatness, and a greater freedom from disturbance produced by extraneous powerful magnets, with our last form of voltmeters than with our earliest.

German Silver or Copper Wire for the Coil of a Voltmeter.—It might appear at first sight that German silver wire would be better than copper wire for voltmeters. As regards the error arising from the change of temperature of the room this is undoubtedly the case, but not as regards the heating of the coils by the passage of the current. For, to produce any given deflection on a voltmeter provided with a given controlling permanent magnet requires a given current for a given number of convolutions; hence, since the specific resistance of German silver is about thirteen times that of copper, the production of heat which necessarily accompanies the production of a given magnetic effect with a given instrument will be thirteen times as great if German silver be used than if copper be used. And, on account of the inferior heat-conducting power of the German silver, the elevation of temperature will be more than thirteen times as great. But for the same elevation of temperature the increase of resistance of copper is only 8·8 times the increase of the resistance of German silver. Consequently, copper wire will be about twice as good as German silver in any case where the change of resistance due to the heating produced by the current flowing through a given coil is concerned.

Methods of Construction for obtaining the Proportional Law.—Next, with reference to the principle that must be followed to obtain the proportional law in galvanometers. In an ordinary galvanometer, controlled by the earth magnetism, the strength of the controlling field is a uniform one, whereas the strength of the deflecting field produced by the current flowing round the coil is strongest in the plane of the coil, and grows weaker as we recede from that plane. Hence, when the needle is deflected, it moves into a weaker part of the deflecting field. The result of this is that the deflections for different currents increase much less rapidly than the current. If both fields be uniform for all positions of the needle, and be at right angles to one another when the needle is in its zero position, then, as is well known, the tangent of the deflection increases proportionately to the current. In order, then, that the deflection may increase proportionately with the current, one of these conditions must be fulfilled—(1) The needle, when deflected, must move into a stronger part of the deflecting field, or (2) must move into a weaker part of the controlling field, or (3) both these results must be true. The first condition—uniformity of controlling field, combined with increase of strength of deflecting field—can be fulfilled by using two solenoids at a small distance apart from one another, but with a common axis, and suspending the needle between them, so that on being deflected it enters the solenoids, and therefore moves into a stronger part of the solenoid field, or it may be fulfilled by suspending a magnet over two flat horizontal coils, C, C, as shown in fig. 4, the distance between the coils being rather less than the length of the needle, and the exact position occupied by wire

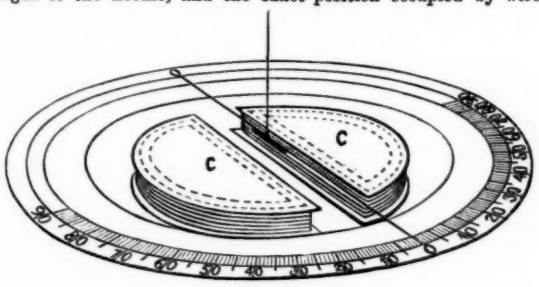


FIG. 4

"ROUGH PROPORTIONAL GALVANOMETER."

being shown by the dotted lines. This mode we employ for making a rough students' laboratory galvanometer, which you see in its embryo state on the table, and with which the deflections are accurately proportioned to the current—at any rate, up to 45° or 50°. If, however, a dead-beat instrument is required, then, in order to ensure roughly uniformity of controlling field, the pole pieces, P, P, of the permanent magnets, M, M, must be hollowed out, as shown in fig. 5, and must embrace the tube, T, in which the needle moves. We have made a number of ammeters and volt-

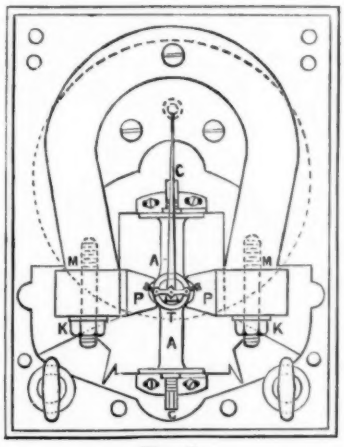


FIG. 5.

"INTERIOR OF DIRECT-READING INSTRUMENT—EARLIER FORM."

meters of this type, and a sample one, dissected, is on the table. The augmentation of strength of the deflecting field is still further produced by the employment of the soft iron cores, C, C, referred to above, and which screw into the brass bobbin, A, A.

But condition 3, the needle moving into a stronger part of the deflecting field, and also into a weaker part of the controlling field, is the one we find the best, and it is the one we are using in all our latest instruments, the interior of which is shown in fig. 3.

Change of Strength of the Controlling Magnet.—In some of our older instruments we have found that the constant did not suffer sensible change during a period of many months; in others that the change during a much less time arising from the falling off of the strength of the controlling magnet was very serious. This latter effect we believe to be partly due to inferiority in the steel, it being very difficult to obtain successive deliveries of magnet-steel from the same manufacturer equally good in quality, and partly from the way in which the armature attached to the instrument, when not in use, was removed from the magnet when about to be used. In some of our older instruments, from the form of construction, the mode of removal of the armature took rather the form of a pull, which is known to be bad for the permanency of a magnet. Consequently, our new non-commutator instruments are so arranged as to make it impossible to use armatures at all, while in our commutator instruments armatures are attached, but the instrument is so constructed that the armature, A, fig. 2, can only be removed by a pure sliding motion, and we shall thus be able to ascertain experimentally whether no armature at all, or an armature put on and removed by a pure sliding action is better for keeping the controlling magnet constant in its strength.

OHMMETERS.

The ohmmeter, as we have already said, we define to be an instrument in which the pointer points *at once* to the number of ohms required to be measured. The method we employ for making such an instrument consists in fixing two coils at right angles to one another, acting on the same soft iron needle. One of these coils, having terminals, T, T, fig. 6, is made of thick wire, and is placed in series with the resistance to be measured, while the other, having terminals, *t*, *t*, is composed of very fine wire, and is put as a shunt to the unknown resistance. Hence the main current produces its effect by means of the thick wire coil and the difference of potentials at the terminals of the unknown resistance on the fine wire coil. Now, by properly proportioning the shapes of the coils, and by winding these coils in a definite way, we have obtained an instrument in which the deflection of the pointer is exactly proportional to the number of ohms, and which we find most convenient for measuring the resistance of any part of an electric circuit, such as the field magnet of a dynamo, or the resistance of an arc lamp while the strong current is flowing. The thick coil is always kept, like an ammeter, in the main circuit, and the terminals, *t*, *t*, of the fine wire attached to any two points the resistance between which at any particular moment it is desired to know. The use of the instrument also permits the employment of an iron wire, or even of a bit of wet rope, as a resistance coil for experimental purposes, the resistance of the iron wire, or of the wet rope being determined with the ohmmeter at the moment the experiment is being made.

Sir William Thomson has recently proposed a new unit, a mho, the reciprocal of an ohm, on account of the difficulty which is found in making people realise that one thousandth of an ohm may be of great importance when you are dealing with a large current. But we do not propose graduating our ohmmeters as mhometers, an operation, of course, quite simple to effect, because—first, if it be found that practical men cannot be got to pay attention to a thousandth of an ohm, we venture to think

that they can probably be got to appreciate its value if it be called a thousand microhms, just as practical men do not disregard the capacity of a mile of submarine cable, when called, as it always is, a third of a microfarad, although possibly they might do so if it were spoken of as a three-millionth of a farad; and secondly, a still greater objection to the adoption of the word mho (ingenious as is this suggestion of Sir Wm. Thomson's, like that of all his other suggestions) is because the constants in connection with conductivity, the reciprocal of resistance, are quite different from those connected with resistance. For example, take the case

FIG. 6.

"DIRECT-READING OHM-METER."

of increase of resistance with temperature. Let R be the resistance of a wire at temperature, t^0 C, and R_0 that at 0^0 C,

$$\text{then } R = R_0 (1 + a\,t),$$

where a is the increase of resistance per ohm per degree.

Now let C and C_0 be the respective conductivities, then

$$C = C_0 (1 - a't)$$

where a' is the decrease of conductivity per degree per unit of conductivity.

$$\text{But since } R = \frac{1}{C}$$

$$\text{and } R_0 = \frac{1}{C_0}$$

$$1 + a\,t = \frac{1}{1 - a't}$$

When $a \times t$ is small, as in German silver, $a' \times t$ the percentage increase of resistance, equals the percentage decrease of conductivity per degree; but if $a \times t$ is large, as in copper, this is not the case; so that while ·388 is the percentage increase of resistance of copper per degree, ·293 is the percentage decrement of conductivity per degree.

NON-SPARKING KEY.

Various so-called non-sparking keys have been devised during the last year or two, but, as far as we are aware, they by no means completely fulfil their object. On breaking a circuit through which a current is flowing a spark is produced, the brilliancy of which depends on the coefficient of self-induction of the circuit, and on the current flowing through the circuit just before the circuit was broken. To completely avoid this spark, the energy stored up in the circuit must be utilised to send a current through an unbroken circuit, and this can be accomplished if the resistance of the circuit, instead of being suddenly varied from a small value to infinity, is increased steadily by the insertion of a resistance increasing at a proper rate. If it increases too quickly, a spark will certainly take place; if too slowly, the wire of the resistance coil which has been added to the circuit will be dangerously heated.

Fig. 7 shows an arrangement which we have devised for introducing this resistance at a proper rate, independently of any control on the part of the person stopping the current. To start the current the handle, H, is turned moderately quickly until the solid piece of metal, M, comes into contact with the brush, B, when a catch holds the key in that position. The current now passes from one of the binding screws to the other, through practically no resistance. To stop the current the little handle, *h*, is slightly pulled, when a spring, S, which was coiled up when the handle was turned round to put the current on, causes the cylinder to turn in the opposite direction, the various pieces of metal projecting from the right hand side of the instrument, coming, in succession, into contact with the brush, B. Between each of the pairs of contact pieces, there is a resistance varying from a small fraction of an ohm for the first coil to some hundreds of ohms for the last. The effect is then that resistance at a perfectly definite rate is added to the circuit before breaking it, which latter is done by the brush, B, coming finally into contact with the last of the pins, which are made of ebonite and not of metal. These resistances are adjusted partly by calculation and partly by trial, so that, with the particular rate of rotation, the coiled spring, S, gives to the barrel of the key, the circuit of an A Gramme machine, sending a fairly strong current, can be broken by the use of this key, without any visible spark. The spring, S, combined with the locking arrangement, makes it impossible for the key to be left partly on or off. If not turned so that the current flows without resistance, then the spring breaks the circuit altogether.

Besides, the advantage this key affords of being able to break an entire electric light circuit without spark, it is possible that another advantage may be produced, viz., that the life of incandescent lamps may be increased by the current which passes

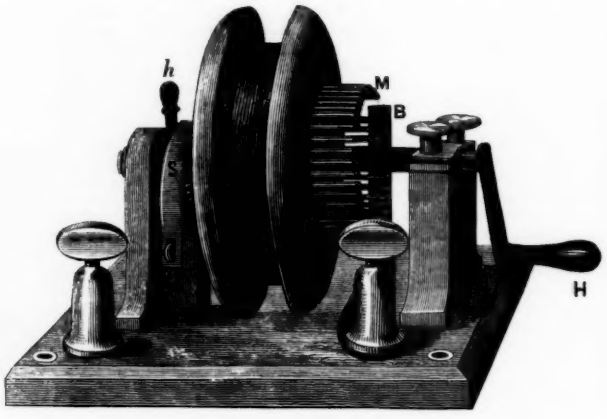


FIG. 7.

"NON-SPARKING KEY."

through them being *gradually* diminished to nothing, instead of being suddenly stopped as is at present the common practice, but whether this second advantage exists, time, of course, alone can show. At any rate, the existence of a non-sparking key now makes it possible for Insurance Companies to turn their attention to the consideration of prohibiting sparks, which previously it was almost useless contemplating.

THE "TOWER" SPHERICAL ENGINE.

ON the opposite page we give two illustrations of this engine, which is manufactured solely by Messrs. Heenan & Froude, of Manchester, who are also the patentees.

The working parts of the engine may be understood from the following description which appeared in the *Engineer* of 10th of August, 1883:—

"It is a rotary engine of entirely novel character, and, as the name almost implies, it consists of a sphere of cast iron truly bored out, forming a chamber, within which the steam acts on suitably arranged pistons, the power being taken off by a shaft revolving through a stuffing box in the ordinary way.

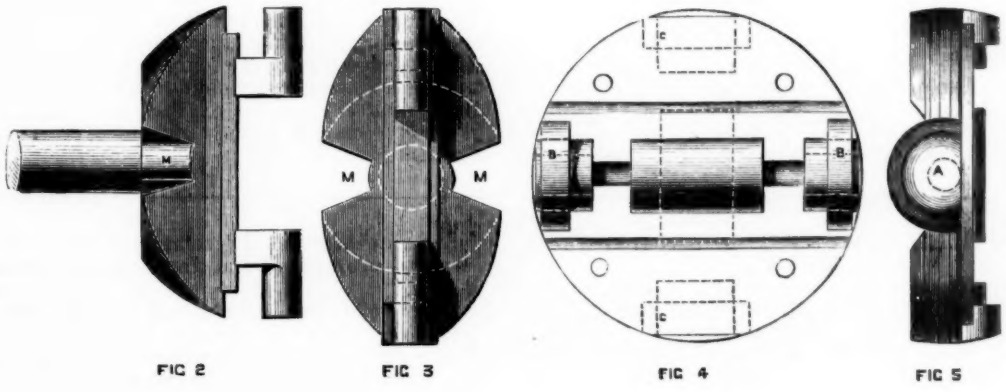
"The following is a description of the working parts:—The piston shown in figs. 4 and 5 is a disc of steel having four phosphor bronze bearings inserted in four recesses, one pair of these, B, B, being on one side of the piston, at right angles to the other pair, C, C, which are at the opposite side.

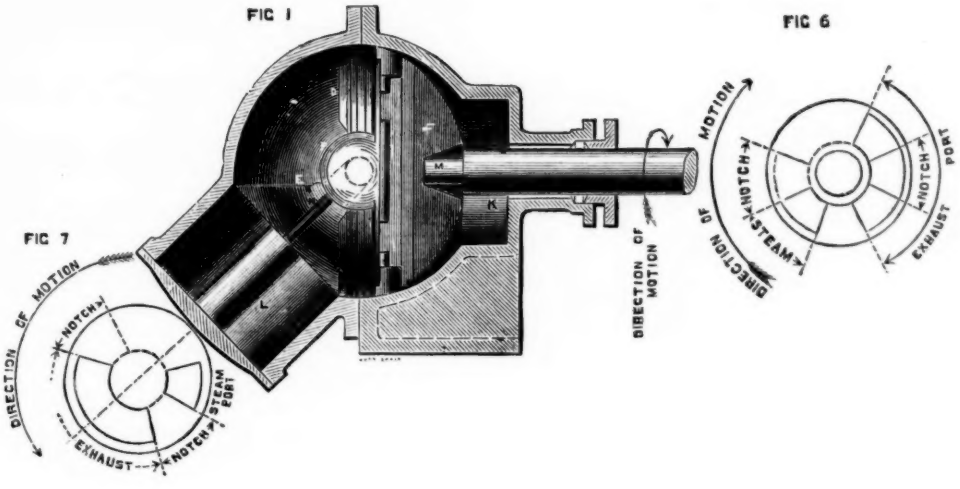
"Referring to fig. 1, it will be seen that there are two shafts placed in the same horizontal plane but not in the same vertical plane, one the driving shaft and the other the dummy shaft, the latter revolving in bearings within the casing, and being inserted merely for giving the necessary movement to the piston. On the end of each shaft is a blade, figs. 2 and 3, these being of wedge shape, convex towards the shaft, and having on their faces turned gudgeons or trunnions, which fit into the bearings, B, B and C, C, on the piston. When the blades and piston are thus coupled together the interior movement is complete, and it may be described as a universal joint with solid matter built up round it so as to form, when revolving, four expanding and contracting chambers. The angle of the shafts is best chosen at 135 deg. In revolving from the position shown in fig. 1, the area, D, E, which constitutes one chamber and is shown fully open, closes, F, G, opens, that on the further side of F, G, closes, and H, which is now closed by contact between the blade and piston, opens.

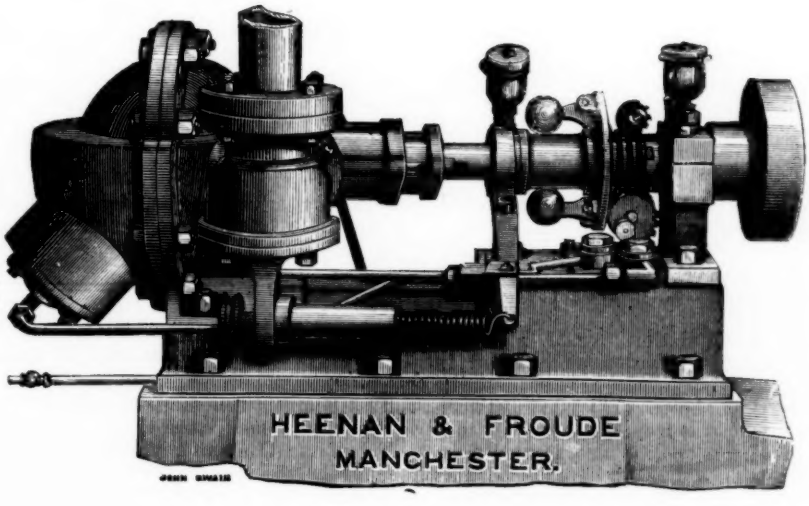
"Steam is admitted to the chambers when they require to expand, and released when they require to contract, and this is accomplished in the following manner:—Two cylindrical excrescences, K and L, are formed on the sphere, and each contains a cylinder (not shown on engravings) having on the face towards the sphere, openings or ports for the ingress and egress of steam (see figs. 6 and 7), and also having around the circumference other openings or ports corresponding with openings formed in the cylindrical shells, communicating by steamways with the supply and exhaust. M, figs. 1, 2, and 3, are notches in the sides of the blades, arranged so that when a blade revolves, a notch comes over the steam port and admits the steam, which is then cut off by a further movement and allowed to expand, while the notch travels between the inlet and outlet ports. A still further movement brings the notch in communication with the exhaust port, and permits the steam to escape when the chamber is contracting."

This engine is claimed to be quite a new invention, and made its first appearance in the Engineering and Metal Trades' Exhibition, held in the Royal Agricultural Hall, in July of last year, where it was used for working a 200-light Edison-Hopkinson dynamo during the time the exhibition was open.

The same engine and dynamo are at present lighting up the manufacturers' premises in Manchester. We







are assured that neither the engine nor the dynamo has been repaired since first set to work in May last, which speaks well for their durability.

The shafts of the engine are of forged steel, working parts casehardened and working against phosphor-bronze. The motion, which is all enclosed in a sphere, is thoroughly lubricated by a self-acting pump, which, in a given number of revolutions, injects a small quantity of valvoline into the inner working bearings and joints of the blades with the piston disc, the quantity injected being in exact proportion to the speed of the engine. It is worked direct off the governor disc, and is placed underneath and to one side of the bed plate, which is cored out so as to form a cistern containing a sufficient quantity of oil to last the engine in question 10 hours. The governor is placed on the driving shaft, and some idea of its sensitiveness may be deduced from the fact that, at the Admiralty trials of a 7 inch engine (employed to drive a 200-light dynamo), 199 of the lamps were switched off, when the remaining one was found not even to flash up. These features, together with the fact, that it is said to be very economical in this consumption of fuel, will render it a most fitting engine for driving electric light machinery on board ship, where economy of space is of such importance, as well as for numerous other purposes. It is believed that its novelty is the only reason that it is not being more universally employed where direct acting high speed engines are required. We may add that Messrs. Heenan & Froude guarantee the facts above stated.

EBEL'S IMPROVEMENT IN MIRROR INSTRUMENTS.

THE mirror instrument, as now manufactured by the well known firms of Siemens Brothers and Elliott Brothers, for working on long lines of cable, are each provided with an adjustable air-tight tube which is placed in the centre of the coil. In this tube there is a small mirror with an attached magnet suspended.

In some cases, in order to obtain a sluggish movement of the mirror, the tube is filled with some liquid, such, for instance, as water or paraffine oil.

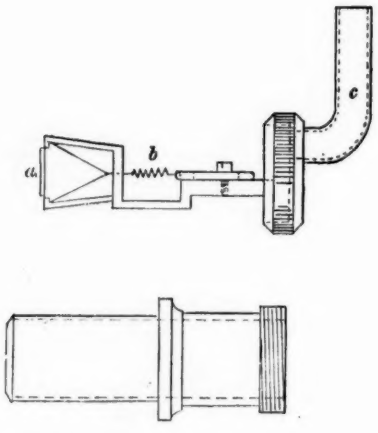


FIG. 1.

Should, however, the mirror become defective and require renewing, difficulty is experienced in effecting such suspension, and the services of a skilful hand are required.

To facilitate such manipulation, Mr. J. Ebel has adopted the construction of instrument shown in the accompanying figures.

Fig. 1. The mirror, *a*, is shown suspended between the prongs of a fork, whose extremities are bent into the form of small hooks; a hook is also formed upon the end of the adjustable spiral spring, *b*. Mirrors have usually attached to them the magnets and fibres. To effect the suspension, the two ends of the fibre are tied or secured to a sling of a certain length, which can be easily obtained by using a template formed of cardboard, and such mirror is placed by the sling in the three hooks.

When liquid is used another obstacle has been experienced as follows:—That is to say, such liquid obtains in time a high temperature, from the concentrated light directed upon it, and causes air bubbles to form, which air bubbles sometimes affect the movement of the mirror, and consequently interrupt the signals.

To prevent such interference with the mirror, the inventor prolongs the tube in the form shown in, *c*, fig. 1; the prolongation is adapted to permit the air or gas produced by the liquid a free outlet.

Fig. 2 shows an arrangement by which the mirror tube can be supplied with compressed air or liquid. The tube is connected with a syringe (or any suitable pumping arrangement), by the flexible tube. The adjustable clamp enables the compression to be regulated.

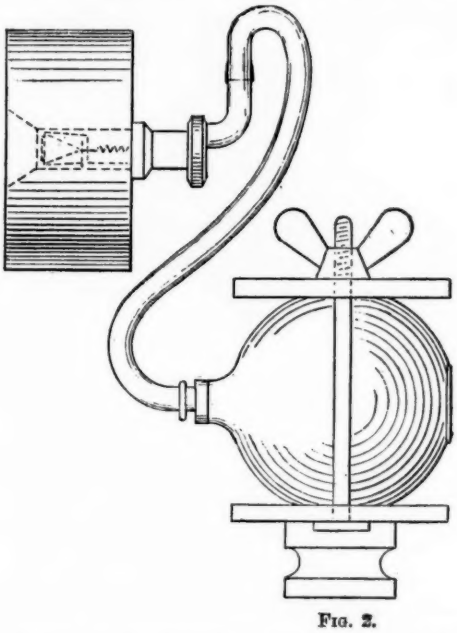


FIG. 2.

TELEPHONE LITIGATION IN THE UNITED STATES—BELL AGAINST DRAWBAUGH.

THE People's Telephone Company, a New York Corporation, was sued some time ago by the American Bell Telephone Company, which owns Bell's patents and controls the telephone monopoly, for an alleged infringement of these patents. The People's Company, in defence, aver that Bell's patents are invalid and void, because Bell is not the first inventor of the telephone; and under the patent law only the first and original inventor of a device can hold a valid patent for the same. The People's Company further aver that Daniel Drawbaugh is the first and original inventor, and that he is entitled to the broadest possible patent for the telephone and the art of telephony, for he made it.

Testimony to substantiate Drawbaugh's claims was

accordingly adduced by the People's Company. Beginning in April, 1881, witness after witness who knew Drawbaugh, and knew what he had done, came forward and told how they had talked and heard speech through his telephones at various dates long prior to the date of Bell's first patent, March, 1876. They picked out and positively identified the instruments they had seen and talked through, and told what words they heard and what they said.

In the suit now pending in the Circuit Court of the United States in New York, witnesses, to the number of 145, identified certain telephonic instruments which they had seen and heard talk in Drawbaugh's shop from 1867 to 1876; and two scientific experts, Park Benjamin and Frank L. Pope, testified "that the Drawbaugh talking machines were electric speaking telephones embodying and containing all the telephone inventions patented by Bell, and that they were practical working instruments, and as good articulating telephones as they had ever heard."

I herewith send you descriptions, illustrated by drawings, of the various instruments made by Drawbaugh which were put in evidence and identified by the witnesses as above stated. From the testimony, it appears to be established that Drawbaugh invented, in 1866, a current regulator, consisting of a vibratory diaphragm or tympan in combination with plumbago, pulverised charcoal or other forms of carbon, thus antedating Edison ten years. It also appears to be established that in 1866 Drawbaugh made a telephone receiver with a membrane tympan in combination with an electro-magnet and vibrating armature, thus antedating Bell nine years; and further, that Drawbaugh in 1870 made a magneto-telephone consisting of a permanent magnet in combination with a plate metal diaphragm, to be used without a battery, thus also antedating Bell's patent permanent magneto-telephone nine years.

It seems almost incredible that the electric telephone, "the greatest marvel hitherto achieved by the electric telegraph," should have been conceived and brought to perfection by one man, and that man "an uneducated workman, living far distant from the world of thought and action," and the whole accomplished within a period of ten years.

W. C. B.

Feb. 11*th*, 1884.

DESCRIPTIONS OF DRAWBAUGH'S INSTRUMENTS.

Drawbaugh's early transmitter is represented in the rough sketch, a fac-simile of one made by himself. It is made of an ordinary china teacup, with a piece of flexible material like membrane, B, stretched over the top. A metal rod, marked with the letter C in the sketch, extends down from the membrane and has at its lower end a plate, E, which rests on a mass of powdered material, F, under which again is another metal plate, D. The current from an electric battery enters by the wire, G, passes to the plate, D, then through the powdered substance, then to the plate, E, and the rod, C, and finally to the line wire by the wire, H. For the powdered material Drawbaugh used many substances, such as bronze powder and other finely-divided metal, fine earth, &c., but ultimately he fixed on plumbago, pulverised charcoal and other forms of carbon as giving the best result. The instrument is operated by speaking before the membrane, B. This, in vibrating, produces variations in pressure on the carbon powder, and the current passing through the powder is then modified in accordance with these variations.

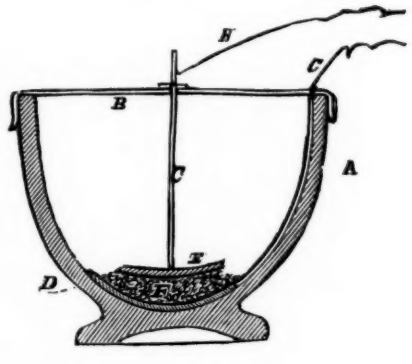


FIG. 1.

In this way he impressed the speech vibrations virtually on the electric current, and, of course, it was necessary to make the current yield them back again, so to speak, at the place where the sound was to be heard. He knew that when a varying current of electricity traverses a coil of insulated wire wrapped around a bar or core of soft iron, the latter becomes a magnet and can attract another piece of iron, for example; and he also knew that when the current was stronger or weaker, the attractive strength of the magnet varied in some proportion. He would have, therefore, his varying current go to such a coil or electric magnet, and that magnet he arranged to attract a piece of iron with which was connected a stretched membrane just like the one which received the spoken words and communicated these vibrations to the carbon powder. This second membrane is the receiving instrument, being thus set into vibration exactly like the transmitting membrane, reproducing in the air similar sound waves to those which affected the latter and thus reproduced the original sound. Drawbaugh's early receiver is represented in Fig. 2 (fac-simile sketch). B is an old mustard can, made of tin, and fastened on its side to a board. E is an electro-magnet, consisting of a coil of insulated wire wrapped around a bent piece of iron. The ends of this coil are connected with the line wire between the distant points. In front of the coil is a piece of iron, F, called the armature, supported on a spring, G. A string, D, from this armature led to a membrane, C, which was stretched across the end of the can, B.

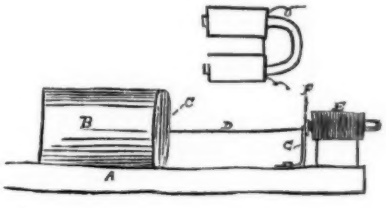


FIG. 2.

The whole arrangement of transmitting telephone, receiving telephone and battery is represented in another fac-simile sketch by Mr. Drawbaugh. fig. 3.

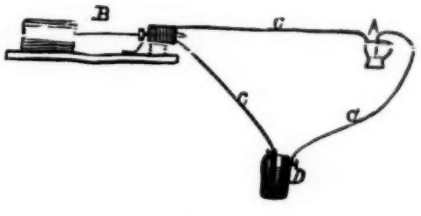


FIG. 3

The current from the battery, D, goes through the wire, C, through the transmitter, A, and through the coil of the receiver, B, and then back to the battery. When anyone talks in the transmitter, A, the magnet in the receiver, B, vibrates its armature and this in turn vibrates the membrane and the speech is reproduced. This apparatus was made in the fall of 1866.

It is one of the most singular facts in the history of Drawbaugh's progress with the telephone that he simultaneously maintained two distinct lines of invention. The receiver above described is substantially the same thing in form, and identically the same thing in principle and mode of operation as the apparatus which Bell constructed. On the other hand, the transmitter operates on a different and converse principle, and works exactly the same as the apparatus which Edison and Hughes disputed over when they brought it out in 1878—when it was hailed as a new and wonderful discovery.

During the following year, 1867, or in the beginning of 1868, Drawbaugh improved his apparatus, and produced the forms shown in figs. 4 and 5.

Fig. 4 is a transmitter made out of a jelly tumbler.

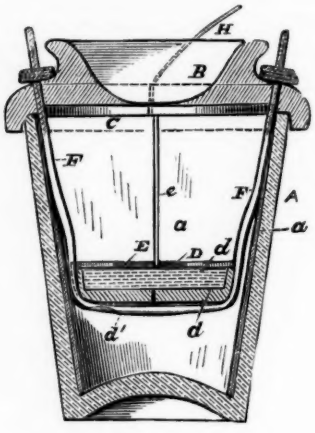


FIG. 4.

It has a wooden mouthpiece, which every one will recognise as similar to that on the receiver in common use, and the carbon powder, instead of resting on a plate in the bottom of the vessel, is supported in a suspended tray. This identical apparatus, though not in complete form, still exists.

The receiver was modified by the suppression of the string and the direct attachment of the armature plate to the membrane. It is identical in all essential particulars of form with one of the instruments which Bell exhibited at the Centennial nine years later. This instrument also, in incomplete condition, still exists.

FIG. 5.

In 1870 Drawbaugh had found out that the telephone could be made to operate without a battery. He discovered that the battery served no purpose except to convert the iron core within the coil of his receiver into a magnet, and this might as well be done once for all by putting in a permanently magnetised core. He found, also, that a plate metal diaphragm was better than one of membrane, and the result of these discoveries appears in the apparatus shown in fig. 6. Here a permanent horseshoe magnet is fastened with its poles in contact with the core of the electro-magnets, thus permanently magnetising these cores. The mouthpiece is a cylindrical box, held in a support and having a plate diaphragm to which the armature is fastened. This instrument transmits and receives speech equally well without a battery, and is nearly identical in construction with the telephone patented to Bell in January, 1877, and the same in all important particulars.

The form of this instrument, still in existence in incomplete form, is large and cumbrous, and within a year Drawbaugh had improved it very materially, producing an apparatus in which instead of leaving the

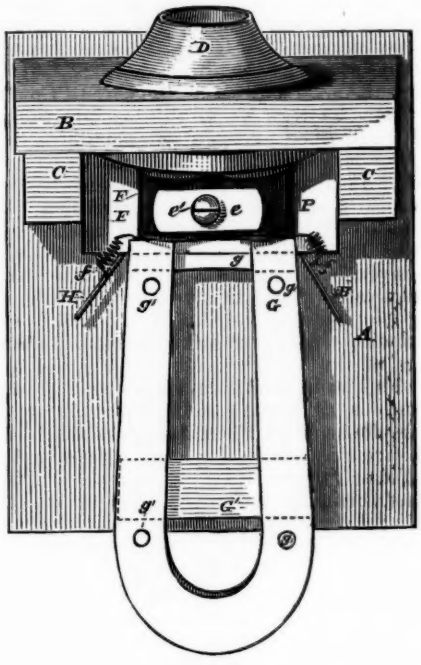


FIG. 6.

diaphragm exposed on one side, he enclosed it and all the working parts of the instrument in a cylindrical box about five inches in diameter. He made the whole diaphragm out of very thin iron plate and reduced the size and shape of the permanent magnets. This instrument also exists in incomplete form.

The efforts of the inventor for the next two years seem mainly, so far as the magneto telephone is concerned, to have been directed to reducing the size of the instrument and rendering it more compact in arrangement and delicate in adjustment. In 1873 or the beginning of 1874 he produced the remarkably perfect apparatus depicted in fig. 7.

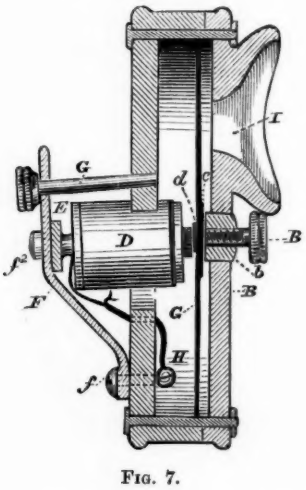


FIG. 7.

This instrument now remains just as he made it, with every part present and in excellent working order. It is a receiver intended for use with a battery, as it has no permanent magnet. It is of flat cylindrical shape, about five inches in diameter, and contains means of adjusting the electro-magnet with nicety. It has frequently been used on telephone lines within

the last two years. Thus, nearly three years before Bell had produced his instrument Drawbaugh had completed a telephone which could to-day be successfully used anywhere.

In January of 1875, Drawbaugh reached a form for his magnet instrument which seems to be as compact as that device can be made. He made two instruments similar to fig. 8, and both of these in perfect form

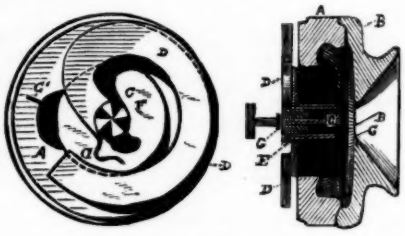


FIG. 8.

exist. Each is about three inches in diameter by an inch and a half thick, and each is for all practical purposes identically the telephonic receiving instrument now in common use. Instead of a bar magnet, which is used in the ordinary so-called Bell instrument, Drawbaugh has a magnet curled flatly against the back of the case, and he has an adjustable core which Bell does not use. It is small, compact, and in every respect an excellent working instrument, which could to-day successfully compete, if the market were open, with any known form of telephone of its class.

Having thus reduced his magneto-telephone in point of size and compactness to the smallest and most convenient form, Drawbaugh turned his attention more particularly to his carbon instrument, in which in the meanwhile he had made numerous important improvements, and finally, early in 1876, he produced the exceedingly compact device shown in fig. 9.

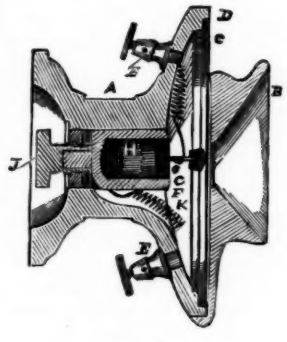


FIG. 9.

Here the plate diaphragm is used, and instead of loose carbon powder, blocks of hard gas carbon held normally in contact by spring pressure are employed. This is an exceedingly sensitive transmitting apparatus, and in its essential features still exists.

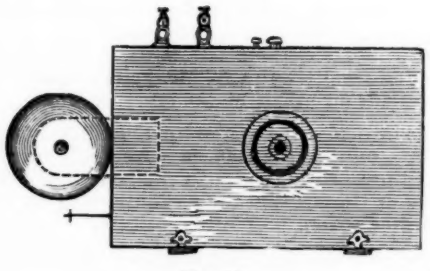


FIG. 10.

Finding out, however, that there was no very material advantage to be gained in making a transmitter of light and portable form—as it could as well be fastened to a wall instead of being movable—Drawbaugh made another apparatus which he had completed and in practical use before August of 1876. This instrument is represented in fig. 10.

It is in every essential particular and almost identically in form the so-called Blake transmitter, now in common use. The carbons are held together by spring pressure, and the instrument contains the induction coil. It exists in perfectly operative condition and is sensitive to a remarkable degree. It has recently transmitted speech uttered in an ordinary tone twenty-three feet away from it.

MAGNETISM IN CITIES.†

IT has long been known that iron when subjected to repeated blows and shocks, while under the influence of a magnet, attains permanent magnetic qualities. Soft iron of pure quality is affected very little in this way, whereas impure wrought and cast-iron sare capable of being permanently magnetised to a considerable extent.

As early as the year 1600, Gilbert experimented in this direction by placing bars of iron in the magnetic meridian and striking them with a hammer. It would require very little imagination, therefore, to suppose that, in a busy city containing iron structures of all kinds, the latter should possess magnetic qualities, since they are constantly subjected to shocks and vibrations produced by traffic.

Such, indeed, is the case, and we propose to give here the results of a few experiments, made with the view of determining their character and extent. The results demonstrate anew the powerful magnetic inductive action of the earth, and show some curious facts. It may be well to remark that in what follows polarity is always designated with respect to the needle, the end pointing toward the north being called the *north pole*; accordingly, therefore, the polarity of the northern hemisphere will be *south*.

The instrument used in these trials consisted of a surveyor's compass; the needle being about four inches long and delicately mounted, so that even very slight indications of magnetism were observed by it.

The first object investigated was the structure of the elevated railroads in New York city, For those not acquainted with them it might be well to explain that they consist essentially of wrought iron posts, or columns, which support trusses or open beams, upon which the tracks are laid.

Beginning with the posts, an examination of a large number of them showed that with very few exceptions they possessed magnetism, and that their *lower* extremities were *north* poles, without a single exception. The examination extended in various directions in the city, and posts distant seven miles from one an other showed the same polarity. It was also observed, that while some gave very strong indications, others gave very little, but not one showed south polarity at the ground. So also did the cast-iron foundation blocks show decided north polarity.

An examination of the superstructure showed that all vertical posts were more or less permanently magnetised, their *lower* extremities being *north* poles. Thus the cast-iron columns which support the roofs of the stations showed this property to a remarkable degree, as did likewise a stove in the waiting room at the station. A screen of half-inch iron rods showed the same property; here also the end of a gas pipe showed south polarity.

As regards the trusses which stretch from post to post, it was found that they were magnetised in such a manner, that their *lower* chords were *north* and their upper south poles. They constitute, therefore, long magnets with poles in the direction of their breadth instead of their length, as is generally the case. The

† *Scientific American.*

same thing was observed on the trusses supporting the stations, which lie at right angles to the ones first mentioned.

The peculiarity of magnetisation in the direction of the breadth of iron and steel bodies is a great deal more common than is generally supposed, and occurred in a case where it was least expected, as will be shown presently.

The writer's attention was next occupied by the Brooklyn Bridge; entering at the New York side, a few minutes' walk brought him to the cables on either side of the promenade. Selecting the most convenient parts of the cables, viz., the *tops* or *upper sides*, and testing them, *south* polarity was shown in both of them. It was natural, therefore, to suppose that the Brooklyn ends would be north poles. Continuing our walk across the bridge and testing the cables at the centre of the span, but also at the top, it was found that they still possessed the same polarity. At the Brooklyn end the cables showed the same indications. Struck by this apparent paradox, the idea immediately suggested itself that the cables were not magnetised in the direction of their lengths, but, on the contrary, in the direction of their diameters.

Testing, therefore, the bottom or under side of the cables, it was found that in every instance *north polarity* was indicated; this was the case both on the New York and Brooklyn ends, as well as in the middle, which leaves no doubt as to the correctness of the conclusion, that the cables are magnetised diametrically. Careful observation showed that the points of greatest intensity lay opposite each other in the line of the magnetic dip, about 76° in this locality. As regards the rest of the iron work on the bridge, it showed the same properties as that of the elevated railroads.

A further confirmation of this peculiarity was established by an examination of the rails in the yard at the Grand Central Depot, where they are subject to the frequent shocks of heavy locomotives. These rails are of steel, and show the greatest irregularities as regards their magnetic qualities, of which they are possessed more or less. Thus, for instance, some were found to be magnetised lengthwise; others, again, like the bridge cables, according to their breadth. In the latter case the top of the rail would invariably attract the north end of the needle, while the *bottom* attracted the *south* pole. The distance between these two positions being only four inches, shows how marked the indications were, as the needle was completely swung around through an angle of 180°. This effect took place especially in the vicinity of switches, where connecting rods joined both rails. All rails free from contact, such as guard rails, were found to possess magnetism at their ends only.

The examination extended also to iron buildings and miscellaneous iron work in the city. Several buildings with cast-iron fronts were examined, and showed that at the *ground* they were *north* poles and contrary at the top. Again, a beam in one of the warehouses now building under the arches of the Brooklyn Bridge was magnetised in the direction of its breadth. The Grand Central Depot consists of iron arches whose extremities at the ground are north poles.

The lamp-posts about town showed marked magnetic properties, as did also the hydrants. All their upper extremities are south poles. In the case of the former the neutral line was found to be on an average at about 12″ from the ground, while in the latter it was close to it, and sometimes below. In buildings heated by steam the radiators were found to be magnetised, with *north* polarity at the *bottom*. Instances could be multiplied indefinitely, but those mentioned will suffice to show that it would be well nigh impossible to procure a piece of iron entirely free of magnetism.

The explanation of all these phenomena is very simple when we consider that the earth is a great magnet, the south pole of which is in our hemisphere. Every piece of iron and steel held vertically will therefore have north polarity induced in its lower end, which will become permanent under suitable conditions. By referring back it will be seen that this law has been uniformly followed, since all the examples given showed north polarity at their lower ends. As regards the Brooklyn Bridge cables, the explanation for their case and similar ones is to be found in the fact that they lie nearly east and west, in other words, at right angles to the magnetic meridian, consequently the direction in which they would tend to magnetise is that of their diameter.

All these investigations are what might be called qualitative, in so far as they only show the disposition of magnetism existing in the bodies mentioned. We reserve for a future article, therefore, an account of the extent of this magnetisation, and the exact effects upon the needle due to these and some other causes which exist in New York city.

NOTES.

Electric Lighting.—From the Easter recess to the close of the session last Autumn the libraries and dining rooms of the House of Commons were lighted by about 270 Edison incandescent lamps. The lighting having been successful some extension of it was deemed desirable by the First Commissioner of Works, and accordingly additional plant has been recently laid down by the Edison and Swan Company, and the total number of lamps is now increased to about 480. The machinery is located in a portion of the basement of the House adjoining the boiler room, and consists of two Armington & Sims' horizontal high speed engines, running at about 300 revolutions per minute; the one engine driving two Edison 250-light dynamos and the other two 150-light dynamos. The distribution of the lamps is as follows:—Dining rooms, libraries, &c, 276; under galleries in the House, pilaster lamps, 32; division lobbies, table lamps, 24; ditto, pendants, 32; ditto, staircases, 4; south entrance lobby and staircases, 13; north lobby, 8; ministerial rooms, lavatories, &c., 16; retiring rooms, &c., 40; reporters' rooms, 21; reading room, 12; total 478 lamps. The existing gas fixtures have in several instances been utilized for the incandescent lamps, by means of ornamental attachments in harmony with the character of the chandeliers. In other cases neat polished brass pendants, brackets, &c., fitted with opalescent shades, have been provided. The conductors are throughout entirely concealed from view, being either carried behind the panelling or encased in mouldings, stained to the colour of the surrounding woodwork. The lamps are arranged on a considerable number of separate circuits, each capable of being lighted or extinguished by its proper switch. In a small apartment, immediately under the floor of the House, about 20 of these circuits converge on a switch board, and can be controlled by the attendant who possesses the key to the switches. In no part of the House will the electric light prove a greater boon than in the rooms set apart for the use of the gallery reporters which have hitherto, owing to their contracted nature, suffered from a highly vitiated atmosphere. The whole of the work in connection with the installation of the light has been carried out under the superintendence of Mr. T. O. Belshaw, of the Edison and Swan company, Mr. Prim supervising the arrangements on behalf of the office of works.

At the next meeting of the Royal Institute of British Architects, on the 18th inst., a paper will be read by Mr. Killingworth Hedges, C.E., on the "Electric Lighting of Houses, and the precautions to be adopted on its introduction."

The s.s. *Manaos*, built by Messrs. J. & G. Thomson, Clydebank, for the Brazilian Steam Navigation Company, of Rio de Janeiro, was fitted with the electric light by Mr. Richard Miller, of 54, St. Enoch Square, Glasgow, a total of 99 lamps, each of 20 candle-power being employed. The saloon was illumined by 21 lamps,

which had a fine effect in connection with the white marble panels, with which the saloon is lined. The remainder of the lamps were distributed about the state rooms, officers' cabins, passages, engine room, and stokehole. The current was supplied by two 60 light machines, both shunt wound, driven by one of Tangye's engines.

Messrs. Woodhouse & Rawson have received an intimation from the Committee of the International Fisheries Exhibition, that they have been awarded a diploma of honour for their incandescent lamps which were exhibited at the above exhibition.

We have received, on the authority of the Anglo-American Brush Electric Light Corporation, Limited, the following tests of a "Victoria" dynamo machine, size "D_2."

Resistance of armature	·025 ohms.
E.M.F. at terminals	60 volts.

External circuit consisted of 200 10-C. P. lamps, which were afterwards replaced by 100 20-C. P. lamps, the results in the two cases being exactly alike.

Current in lamps	120 ampères.
„ „ fields	7·85 „
„ „ armature ...	127·85 „
Actual horse-power absorbed ...	11·26

Electrical energy—

		Watts.	E.H.P.
In lamps	120 × 60 =	7200 =	9·648
„ fields...	7·85 × 60 =	471 =	·631
„ armature ...	$(127·85)^2$ × ·025 =	408·6 =	·547
Total ...		8079·6 =	10·826

Efficiency of conversion $\frac{10·83}{11·26}$ = 96·15 per cent.

Electrical efficiency $\frac{9·648}{10·83}$ = 89·08 „

Commercial efficiency $\frac{9·648}{11·26}$ = 85·68 „

Last week the Glasgow Town Council appointed the Lord Provost and five other gentlemen to assist the gas committee in considering and reporting upon the whole question of electric lighting in their city.

The Brockie arc lamp was shown with great effect at Dorking recently, on the occasion of H.R.H. the Duke of Albany visiting that town. An arc light of 2,000-candle power was suspended in the centre of the High Street, fed from an A Gramme machine, which was driven by a small engine at a brewery near. Crowds of people were attracted by this novelty for Dorking, and from 8.30 p.m. to 3.30 a.m. this lamp gave a most brilliant and steady light, and was highly spoken of by all. The whole arrangements were carried out by Mr. A. de Sanbergue, C.E.

A correspondent informs us that two important installations of the electric light have recently been started in the neighbourhood of Leeds, by Mr. Wilson Hartnell. The first is the corn mill of Messrs. Reynolds & Haselgrave, of Wakefield, the plant consisting of one Crompton-Burgin dynamo machine of the compound self-regulating type and 50 Swan lamps of 20-candle power each. The lamps are scattered in all directions, amidst machinery in the stive room and in many places where gas would be inadmissible—the result here is highly satisfactory. The second is Messrs. Peel Brothers & Co., of Thornton, near Bradford, which consists of one Crompton-Burgin machine of the C type, and 5 arc lamps of the Crompton-Crabbe type. The lamps are placed in their burling and knotting room. Burling is a thing which requires a strong and good light, and this is only obtainable by using the arc system. Hitherto they have had to put their dark shades away, and work on light coloured goods when it became dusk, but now they can work on dark coloured goods at night. This installation is also very satisfactory, and will undoubtedly help to bring electric light more prominently before the manufacturers of the North of England.

The main buildings of the World's Exhibition, which opens in December next at New Orleans, will be furnished with 15,000 incandescent lamps, while the grounds will be lighted by three arc lamps of 3,200-candle power each, together with such smaller arc lamps as may be required.

Telephony.—Arrangements are in course of completion by which a general system of telephonic communication will be established between the various police stations in Dublin and the suburbs and every householder. It is intended to have street telephone-stations to which admission will be gained by means of a private key, and as each station will be in direct connection with the police office of the district constabulary, assistance will be obtainable at any time in a couple of minutes. Every householder may in this way have command of a telephone.

The telephone (says the *Pall Mall Gazette*), continues to make rapid progress on the Continent. The Bourses of Berlin and Magdeburg have just been placed in telephonic communication, with complete success, despite that the distance is 142 kilometres. The cities of Leipsic, Berlin, and Hamburgh will shortly be connected in the same way. There is perhaps, less long-distanced telephonic communication in England than in any other European country where the telephone has been generally adopted. Even in Belgium, where there are not many more people than are contained in the London area of taxation and police, most of the large towns are connected by telephone with Brussels, and those that are not so connected already very shortly will be. But at present the telephone in England is a luxury.

Overhead Wires.—Last Saturday, Mr. W. Wynne-Foulkes, County Court Judge, again sat at Chester as arbitrator in the action brought by the Postmaster-General against the Winsford Local Board, to show cause why the Post Office should not be allowed to erect an overhead line of telegraph through the district. The postal authorities are erecting poles to carry additional wires from London to Liverpool, and all the authorities through whose jurisdiction the wires would pass had given their consent, with the exception of the Winsford Local Board. The main objection urged was the unsuitability for the erection of posts and stays of a thoroughfare through which the Post Office authorities desired to pass. After listening to the arguments on both sides, the judge reserved his decision.

Mr. J. Ford, secretary of the London and Globe Telephone and Maintenance Company, Limited, writing to the *Standard*, says:—Notwithstanding the extraordinary violence of the recent storms, which have done so much general damage in the Metropolis, not a single wire or fixture made by this company has broken or fallen, although some hundreds of miles of wire have been run. I think this fact conclusively proves that if proper materials are used and maintained there is no real danger from overhead wires. At the same time I should add that, having an efficient instrument for underground working, this company would be quite willing to place its wires underground, provided all other companies were obliged to do the same. It is merely a question of the extra expense of running underground.

Personal.—The Royal Astronomical Society has awarded Mr. A. Ainslie Common its gold medal for his photographs of celestial bodies. It is not often that a non-professional astronomer has gained the honour of gold medallist. Since the award to Mr. De la Rue, in 1862, for his photographs of the solar eclipse, Messrs. Huggins and Miller received a joint medal for their researches in astronomical physics in 1867, and Baron Dembrouski one for double star work in 1878, the fourteen other medals going to the professional astronomers. Mr. Common, we may add, is well known in electric lighting circles, and some three years ago he invented a very good and simple arc lamp.

The Monthly Correspondent.—This is the title of a small eight-paged monthly journal hailing from

Madeira, and dedicated to the staff of the B. S. T. Company. We have received copies of Nos. 1 and 3, but as No. 1 was incomplete, we preferred not to mention the little serial at the time of its formation. The design of the promoters is, that each individual member of the company's staff should feel himself equally called upon to contribute his share towards the monthly *quantum* of interesting items and general information. So far as we can judge, the journal will, in addition to being very amusing, contain instructive articles also, and it appears to be well fitted for its purpose. We wish it every success.

General International Exhibition, Budapest, 1885.—We have already notified that the term of application for space in this exhibition has been extended to the end of April of the present year. It is now further stated that paragraph 12 of the general rules, has been so far modified, that one-third of the rent for space shall be transmitted to the General Commission at Budapest, on the filling up of the application for admission; one-third by the end of June, 1885; and one-third before the removal of the objects exhibited.

The Société Internationale des Electriciens.—This society, although only recently started in Paris, has already developed into a numerous and thoroughly representative body. It now counts some 1,200 members, of whom about 300 are foreigners, including nearly 100 English. The honorary president for France is Monsieur J. B. Dumas, secretary of the Acadamie des Science, and the executive president is Monsieur Georges Berger, well-known to most electricians as the chief commissioner of the Paris Electrical Exhibition of 1881, and to whose exertions and *savoir faire* the great success, of that greatest of electrical exhibitions was undoubtedly due. The first regular monthly meeting of the society was held in the lecture theatre of the Société de Geographie, Paris, on Wednesday evening the 6th inst., and was fully attended. Monsieur Berger presided, supported by Messieurs Blavier, Tresca, Jamin, and Lœwy, vice-presidents. After some formal business the meeting elected the members of the committee to represent each of the following countries; those chosen for England were, honorary president, Sir Charles Bright, members, Mr. W. H. Preece, of London, and Mr. J. Aylmer, of Paris. The other honorary presidents elected were for Germany, Dr. Helmholtz; the United States, the Hon. L. P. Morton; Russia, General Velitscho; Belgium, M. Melsens; Italy, Professor Rossetti; Spain, Senor Urena; Holland, Professor Bosscha; Norway, Dr. Broch; Sweden, M. Curchod; Portugal, M. de Pania. A couple of papers were then read by M. Carpentier, and M. Gaulard, and after a brief discussion, the meeting broke up.

The Saigon Cable.—The *Times* states that the telegraph steamer *Kangaroo* laid the cables along the bank of the Doson river on the 1st inst., and that she was expected to reach Saigon on the 12th.

The Bennett-Mackay Cable.—It is announced that Mr. Ward, the New York General Superintendent of the Direct Cable Company since its organisation ten years ago, has resigned, to take a like position on the Bennett-Mackay cable.

Electrical Measuring Instruments.—On Thursday, the 14th, Professors Ayrton and Perry were announced to read a paper at the Royal Society, on "A New Form of Spring for Electric and other Measuring Instruments," and to exhibit the various apparatus in which they have practically applied the new spring. We understand that they have by means of it constructed a weighing machine of great simplicity and delicacy, and an ammeter and voltmeter, in which a deflection of over 200° directly proportional to the current is obtained, without the employment of any friction-producing magnifying apparatus, such as a system of levers, or a wheel and pinion. We understand, also, that no permanent magnets are used, so that considerable constancy of the readings may be expected.

The Theory of the Gramme Machine.—Mr. Mordey sends us a postscript to his letter, too late, however, for our correspondence columns, in the following words:—"May I ask you to allow me a little additional space to reply to the letter of M. de Wolffers? That gentleman's explanation of the manner in which he believes the inside wires of a Gramme ring are influenced by lines of force is ingenious, and certainly illustrates very well the manner in which he proceeded in inventing the diagrams published in your issue of the 12th ult. But is he quite sure that the lines of force, in an arrangement such as he has sketched, follow the directions shown? Experiment will, I venture to think, not confirm his hypothesis. Has he read the following words of Faraday, written in connection with this subject:—'I feel bound to let experiment guide me into any train of thought which it may justify, being satisfied that experiment, like analysis, must lead to strict truth if rightly interpreted; and believing, also, that it is, in its nature, far more suggestive of new trains of thought and new conditions of natural power.'—'Exp. Res.,' vol. iii.. p. 362. I will not trouble you with any account of experiments of my own, but will, instead, draw attention to those of Faraday, described in the volume from which above quotation is taken. Fig. 7, plate iv. shows the actual direction taken by the lines of force in an arrangement precisely similar to that given in M. Wolffers's diagram. This figure—and there are others in the volume to the same effect—quite contradicts the conclusion arrived at by M. Wolffers, the curves in whose figure are exactly opposite to those obtained by Faraday."

A Paper Insulator.—Mr. Charles C. Hinsdale, of Cleveland, Ohio, has invented an electrical insulator constructed of paper pulp. Liquid silica, or silicon, is used as a cementing agent, and when these constituents are combined in proper proportion, a superior insulator is said to be produced.

Safety Lamp Competition.—We read that nearly sixty lamps have been sent in to compete for the prize of £500 offered by Mr. Ellis Lever for the best safety lamp. They come from various parts of the Continent, America, and the United Kingdom. The apparatus erected at Woolwich by the Royal Commission on Accidents in Mines will be placed at the service of the adjudicators as soon as the experiments conducted by the Commission are over; but it will necessarily be some time before the award, if any, can be made.

Telegraph Service Revenue.—The receipts from 1st April, 1883, to 2nd February, 1884, were £1,485,000; against £1,450,000 from 1st April, 1882, to 3rd February, 1883.

The Pilsen-Joel and General Electric Light Company *v.* J. G. Osborne & Co.—This was a motion before Mr. Justice Pearson on Friday the 1st inst., on behalf of the above company for an injunction to restrain the defendants from further publishing or issuing a certain circular, dated 27, Red Lion-square, December, 1883, and addressed to the shareholders of the company, or any circular, notice, or advertisement to the same purport or effect. Previously to the above circular, there had been a circular issued by the defendants to the shareholders of the company in July, 1883, setting forth certain facts relating to the general finances of the company, and calling upon the shareholders to form a committee of investigation, and to sign a document authorising the defendants to act for them; and, having received a number of authorities, they then issued the circular in question, stating many particulars relating to the affairs of the company, which were alleged to be untrue and irrelevant, and calculated to injure the company. Mr. Higgins, Q.C., and Mr. Rawson appeared in support of the motion; and Mr. Cookson, Q.C., and Mr. Beddall for the defendants.

Mr. Justice Pearson said it was a question of considerable difficulty, whether and under what circumstances the court ought to interfere with circulars addressed by one shareholder to his fellow shareholders. This circular was issued by J. G. Osborne & Co., who represented (as they alleged) 80 shareholders. It was contended that this was untrue and that they represented no shareholders, but it appeared that at any rate they represented some shareholders, although the evidence was not very clear as to how many shareholders had authorised them to appear on their behalf. His Lordship could not on that ground interfere to restrain the circular being issued, because he was satisfied that the statement was substantially true, though perhaps, not to the full extent set forth. Then there was a statement concerning the accounts, and the misleading nature of the balance-sheet was referred to. From the evidence upon this subject, his Lordship could not say that upon the face of the circular the statements were so misleading and incorrect that the company could complain. The next statement was that the patents had become valueless, but that was a matter of opinion. The allegation seemed to have been made upon a statement that many of the electric lighting companies had been unable to pay dividends, but this was not a statement upon which an injunction could be granted. The next paragraph complained of had reference to the Electric Lighting Act, 1882, which was said to be injurious to the interests of the companies. This, however, was a question of law, and he was unable at the present moment to say how far the statement was well founded. The next complaint was of the suggestion that pressure should be brought upon the directors (the majority of whom were promoters) to wind up the company. It was said that the majority of the directors were not promoters, and this appeared to be true at the present time, but whether they were or not promoters, was not clearly proved upon evidence, and the statement had reference to a previous time, when the circular was first issued. There were other objections to the circular, but they were of less importance, and upon the whole he could not come to the conclusion, that the statements were in effect so misleading as to enable him to say that the defendants had trespassed beyond the power which one shareholder had of communicating with the other shareholders. The motion must, therefore, be refused, with costs.

Wheeler *v.* The United Telephone Company.—In the Queen's Bench Division, at the end of last month, before Mr. Justice Watkin Williams and a common jury. The plaintiff in this case brought an action against the defendants for breaking and entering upon land which he occupied at Stratford, and erecting telephone-posts upon it without his permission. The defendants, whilst denying liability, paid £5 into court as sufficient satisfaction. Mr. Fillan was counsel for the plaintiff, and Mr. Cock was for the defendants. The plaintiff said that when the defendants' men came to put up the posts on his farm he went to protest against the proceeding; that thereupon they asked him, "Who are you?" and that on his stating he was the tenant of the farm, they said they did not care, they had authority to erect the posts on the land, and would throw him and his servants into the river if they interfered. The defendants' men denied having used any such threat. Mr. Cock said his clients proceeded to erect the posts by the authority of the East London Water Works Company, believing at the time that this company was entitled to give it. Finding afterwards that this authority did not extend to the land where some of the posts were being erected on the plaintiff's farm, which was held of the Great Eastern Company, the defendants desisted, had one of three posts which had been put up removed, and undertook that if he would allow the posts to stand and some more to be erected they would pay him a yearly rent of 7s. 6d. for each, and be responsible for any injury which might arise from their presence there. The offer had not been accepted, and the defendants met the action by paying the £5 into court. In answer to the judge, Mr. Cock said he was prepared to admit the trespass, so that the only question would be as to whether the £5 paid into court was sufficient. The judge was of opinion that it was sufficient, and the result was a verdict for the plaintiff on the question of his title to resist the erection of the posts, which the defendants in their pleading had disputed; and a verdict for the defendants in regard to the quantum of compensation. A question arose as to how judgment should be entered on that result, and ultimately the learned judge held that on the verdict which had been found, the general judgment in the action must be for the plaiutiff; but on the application of Mr. Cock, execution was stayed pending an appeal.

International Electrical Exhibition, Philadelphia, U.S.A.—For the convenience of exhibitors at this exhibition, which is to be opened on September 2nd, and closed on October 11th, 1884, arrangements have been made with Messrs. E. H. Bailey & Co., to attend to all matters pertaining to the entry of goods at the Custom House in Philadelphia or New York, the transportation of the same from the port of entry to the exhibition building, and in the exportation at the close of the exhibition, or their withdrawal for sale. A circular of instructions to shippers has been issued by Messrs. Bailey. With regard to the effects of the exhibition of new inventions upon the rights of inventors, the following information is given by the committee:—1. No person but an inventor, or his assignee, under a written and recorded instrument, can obtain a valid patent, so that no exhibitor incurs any risk of losing his rights by his invention being fraudently patented here. 2. No person can obtain a valid patent for an invention which has been in "public use or on sale in the United States for more than two years prior to the application for a patent." 3. The only effect of the exhibition of a foreign invention in the United States is, that the article exhibited may thereby be deemed to be put "in public use or on sale," and the period of "two years" would then commence, and from that time continue to run. If within two years after such exhibition of his invention, the inventor should make application for a patent, his rights will not in any wise be impaired by the fact of such exhibition, but on the contrary, the very fact of the exhibition of his invention would tend to establish the inventor's right to a patent within the two years, provided he was otherwise entitled to it. The classification of the objects proposed to be shown has been carried out in an exceedingly able manner, as may be seen from the following list, which we find in the *Electrical World*, appertaining to electric lighting apparatus only:—Dynamo-electric machines and accessories; direct and alternating currents; arc light machines; incandescent light machines; plating machines; telegraphic machines; field-magnets; arrangement and disposition of field; series-wound magnets; shunt-wound magnets; shunt and series-wound magnets; multiple coil-wound magnets; magnet cores, construction and ventilation of; pole pieces, shape and proportions of; armatures; construction of cores; devices for ventilating or cooling cores; for preventing induction currents in armatures; insulation of cores; arrangement of armature coils; connection of armature coils; ventilation of armature coils. Commutators.—Disposition of commutator segments; insulation of segments; devices to avoid short-circuiting of commutators; for automatically oiling commutators; for removing wearing segments of commutators; for avoiding sparks in commutators; air-blast attachment for commutators. Brushes or collectors.—Construction; devices for controlling position of brushes; automatic electric governors for brushes; non-automatic governors for brushes. Machine bearings.—Journals, boxes, oil-cups; devices for preventing heating of shafts. Special devices for dynamo-electric machines.—Devices for turning out lights; for changing character of current fur-

nished by machine ; for preventing injurious effects of short-circuiting of machines. Arc and incandescent lighting : arrangement and distribution of circuits.—Insulation of circuit ; safety devices in circuits ; switch boards ; devices for hanging lamps ; chandeliers and brackets for electric burners ; arc-lighting lamps ; switches on lamps, automatic and hand ; direct and shunt magnets in lamps ; clutches for holding carbon rods ; dash pots for lamps ; devices for preventing vibration of lamps ; carbon holders ; devices for securing a proper alignment of carbons ; devices for moving globes to secure facility of introducing carbons ; automatic cut-out devices for preserving continuity of circuits ; double carbon lamps ; multiple carbon lamps ; Jablochkoff candles ; lamp frames ; devices for insulation of frames ; focussing lamps ; globes and shades for lamps ; general construction and shape of ; transparency, or translucency of. Lamp hoods.—For protection against weather or fire. Mirrors and reflectors for arc lights. Carbons for arc lighting.—Materials employed for carbons ; grinding apparatus for carbons; hydraulic presses used in manufacturing carbons ; ovens used in baking and re-baking carbons ; processes for electro-plating carbons. Incandescent lighting.—Carbon filaments for electric lights ; preparations of material for filaments ; substances used for filaments. Preparation of incandescing filaments.—Methods employed for carbonisation ; for driving off occluded gases ; for insuring uniformity of electrical resistance ; electrical testing of filaments. Leading wires.—How cemented to filament ; how secured to the enclosing glass globes. Glass globes for incandescent lamps.—Peculiarities of construction ; how exhausted, sealed, and protected against leakage. Lighthouses.—Lamp focussing ; flashing lights ; fixed lights ; apparatus for removing lamp instantaneously. Dioptric apparatus for electric light plants. Submarine lighting. Applications to submarine explorations, fishing, &c. Electric illumination of buoys. Locomotive head-lights. It is expected that interesting electrical apparatus will be sent from Europe.

The Late Sir W. Siemens' Will.—The will of the late Sir William Siemens, F.R.S., D.C.L., LL.D., of 12, Queen Anne's Gate, Westminster ; 3, Palace Houses, Bayswater ; and of Sherwood, Tunbridge Wells, was proved on December 29th, 1883, by Mr. Alexander Siemens, Mr. Joseph Gordon-Gordon, and Mr. John Wreford Budd, the executors thereof, the probate being stamped to cover personal estate in the United Kingdom, of the gross value of £382,423 12s. 5d. Under the will, which is dated August 21st, 1882, Sir William Siemens gives to his widow, Lady Siemens, certain pecuniary and specific legacies, and an annuity of £4,000, and a life interest in his freehold property, Sherwood, Tunbridge Wells. He gives various pecuniary and specific legacies to relations, friends, his assistants, and others ; £2,000 to the German Hospital, Dalston ; and £1,000 each to the German Society for Benevolence, the Tunbridge Wells Infirmary, the Scientific Relief Fund of the Royal Society, the Benevolent Fund of the Institution of Civil Engineers, and the Pension Fund of Siemens Brothers and Co. (Limited). There are also legacies to domestic servants who have been five years in his employ. The testator makes provision by his will for the carrying on, under the same management as during his lifetime, of his civil engineering business, including his patented inventions ; and his residuary estate is directed to be held in trust for such of his brothers and sisters and nephews and nieces as were living at his death, and, as being males, have attained or attain 21 years of age, or, being females, have attained or attain that age, or have married or marry, in equal shares.

Telegraphy and Telephony in Queensland.—The report of the Post and Telegraph Department of Queensland for the year 1882 is just to hand, and we observe that much progress is being made. The revenue of the Telegraph Department was £60,163 17s. 5d., an increase of £16,223 3s. 7d. on the previous year ; the expenditure was £69,281 0s. 5d., or £7,108 16s. 7d. more than in 1881. The extensions completed since the previous report comprised 843¼ miles of wire, the increase, allowing for line abandoned, being 717¼ miles ; the total mileage open to public business was 6,420¾ of line, and 9,849¼ of wire. At the close of 1882 there were 187 stations in daily operation, and 446 officers employed. The lines throughout the colony worked well during the year, the longest break not exceeding two days. Existing cables were much improved, and a land line was built across Peel Island from the landing place of the cable opposite Cleveland to the Quarantine Station, and thence to a test-house opposite Dunwich. There were about 200 miles of wire in use in the colony for telephonic purposes, 175 offices and places of residence being connected with the exchange at Brisbane, which is kept open day and night, Sundays and holidays included.

Telegraphs and Herring Fishing in the North of Scotland.—A correspondent writing to the *Scotsman* a short time ago, mentioned the fact that a large quantity of herring had appeared in Loch Glendhu, West of Sutherland, but that, owing to the want of telegraphic communication along the coast, thousands of crans might have been taken that were not, the fishermen remaining ashore, as there were no buyers. He states that, along the whole of the coast from Ullapool in Ross-shire, to Thurso in Caithness, the Government and Post Office refused to lay down a telegraph wire. There is no wire from Loch Inver along the coast to Tongue, a distance of about 50 miles, and the population, engaged in the fishing of cod and ling, lobsters and other fish, feel this, with the remaining inhabitants of four large parishes, as a severe loss. There is no fishing now in progress in Lochs Eriboll, Inchard, or Laxford, although known to be full of fish. The correspondent continues :—"How differently the Government of Norway treat their fishermen ! Though comparatively poor, they have established a network of telegraph lines along their coast, so that whenever cod or herring appear in any locality it is instantly wired along the coast, and the fishermen at once assemble there and reap the benefit ; while our rich, money-making Post Office Department will not expend a farthing to benefit the poor crofters and fishermen of the north and west of Sutherland."

Novel Lamp-posts.—At several street corners in Launceston, Tasmania, according to the *Colonies and India*. the ordinary lamp-posts have been superseded by the poles recently erected in connection with the telephonic exchange. The supply-pipe has been carried up the front of the telephone post, and the lamp is supported at a sufficient height to be above the risk of injury from vehicles passing under it, on a neat iron bracket projecting from the post. The new style is neat, and seems a decided improvement on the old serviceable, but certainly not ornamental, style of lamp post.

Companies' Shares.—On Thursday, at the rooms of the Stock and Share Auction and Advance Company, shares of the Electric "Sun" Lamp and Power Company, sold at from 5s. 6d. to 9s.; Exchange Telegraph Company's shares fetched from £5 5s. to £5 7s. 6d. ; and those of the Montevidean and Brazilian Telegraph Company, £2.

DISSOLUTION OF PARTNERSHIP.

Norman and Son (John Musgrove Musgrove, Hubert Musgrove Musgrove, and William McWhirter), electrical engineers, Barrow-in-Furness and Glasgow, from the 31st December last.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Lyons Electrical Power Storage Company, Limited.—This company has entered into an agreement, dated 3rd ult. (filed on the 31st ult.), to purchase from M. Jean Baptiste Ernest Lamy, of Lyons, certain Letters Patent relating to electric apparatus, referred to in an agreement of 18th July, 1883. Under the agreement of that date, the purchase consideration was to have been £76,000, payable £52,000 in fully paid shares, and £24,000 in cash. It is now agreed that in lieu of the cash payment, 14,000 fully paid ordinary shares and 10,000 fully paid Saint Etienne preference shares shall be allotted to the vendor.

Electric Brush and Appliance Company, Limited.—By an agreement of 30th November, filed on the 31st ult., this company will purchase the patented inventions of Joseph Norman Aronson, of Old Broad Street, in connection with the manufacture and construction of electric brushes. The purchase consideration is £1,000 in cash and 3,000 fully paid shares of £1 each.

Electric "Sun" Lamp and Power Company, Limited.—The annual return of this company, made up to the 5th inst., was filed on the 11th inst. The nominal capital is £200,000 in 40,000 shares of £5 each. 7,759 shares, upon which £4 per share has been called up, have been allotted to the public, and 16,500 have been allotted to the vendors as fully paid. The calls paid amount to £29,180 10s., and considered as paid to £82,500, leaving £1,855 10s. unpaid. The above statement shows an increase of £8,612 10s. in the paid-up capital as compared with last year's return.

J. B. Rogers Electric Light and Power Company, Limited.—By an order of the High Court of Justice, Queen's Bench Division, dated 9th inst. the above company is directed to remove from its register of members the name of Mrs. Margaret Chrystie Underwood.

Telephone Company of Austria, Limited.—By an agreement of the 8th inst., this company agrees to allot to the Consolidated Telephone Construction and Maintenance Company, Limited, 2,000 fully paid-up shares of £5 shares, in consideration of what remains due of a sum of £45,000 payable to the Edison-Gower Bell Telephone Company of Europe, Limited, under an agreement of the 28th July, 1883.

Electrical Insulator Manufacturing Company, Limited.—The second return of this company, made up to the 11th ult., was filed on the 6th inst. The nominal capital is £100,000 in £1 shares. 19,516 shares have been allotted, and the full amount has been called thereon. The calls paid amount to £17,857, leaving £1,659 unpaid. The paid up capital shows an increase of £1,310 as compared with last year's return. Registered office, 31, Lombard Street.

British Spiral Telephone Wire Company, Limited.—The registered office of this company is at 28, Southampton Buildings, Chancery Lane.

CITY NOTES, REPORTS, MEETINGS, &c.

Metropolitan (Brush) Electric Light and Power Company, Limited.

AN extraordinary general meeting of this company, was held at the City Terminus Hotel on Tuesday, for the purpose of considering a number of resolutions agreed to by the directors and the committee of investigation recently appointed, relative to the winding up of the company. Mr. J. H. Borrer, chairman of the company, presided.

Mr. Robert Wilson, the secretary, having read the notice convening the meeting,

The Chairman said before the first resolution—to adopt the report issued by the committee—was put, he desired to afford some explanation of the position. He understood that the directors were represented as desirous, in the legal matters pending, of protecting the promoters, and as being altogether unwilling to enter into legal proceedings; but both assertions were equally wrong. At the last meeting they thought they would have been culpable in spending money in law suits, but since then some further facts had come forth which made the case seem much stronger, and they were not unwilling to take the chances of the law. He could not withhold his opinion that liquidation would greatly complicate the matter; and it was his duty to point out that it would give the Anglo-American Company the right to refuse to pay any royalty on their business. [Frequent interruptions took place during the Chairman's speech, there being loud cries for the committee, and for several minutes confusion prevailed.] He must remind them that beside the report, many circulars had been issued, in which many statements had been made which it was certainly his duty to answer. The history of the relations between the board and the committee up to the end of last month had been placed before them in various circulars; but on the day on which the committee's report was posted, at Mr. Brown's request he met that gentleman at the offices of Mr. John Morris. He was then informed that unless the board agreed to the notice for that meeting being sent out before seeing a copy of the report, the committee would "take their own course." The wording of some of the resolutions was slightly altered, and, thinking every concession likely to promote peace a duty, he signed it. He was quite unable to understand, however, why the notice would not have done quite as well if sent out on the following day, when the board would have had the opportunity of seeing the report. The directors were said to have broken faith; but that report set forth in a decisive manner that they could not carry on the provisional orders, whereas the distinct understanding between the board and the committee was that the provisional orders were to be preserved and the business of the company carried on. [Mr. Brown here rose to speak, and the chairman was interrupted with cries of "sit down," "chair," "Mr. Brown," and confusion. Mr. Brown, however, resumed his seat without speaking.] The Chairman proceeded to explain that there was no breaking faith on the part of the directors, and then said he could not help alluding to the bitter and venomous circulars last issued, one of which affected his position and that of Mr. Tottenham as directors. The statement that he told the committee that he was pledged to defend the original directors was not true. He had no desire to defend the conduct of any person who had acted improperly in connection with that company. He summed up the position in the following manner:—The committee said to them, "Fight, and don't work;" and the board said, "Fight, and work too." The committee had intimated very plainly that they believed the talk of the board about overtures having been made for purchasing the company to be humbug, and shortly after came the astounding declaration that the committee had filed a petition for winding up. The gentleman they had alluded to was present, and would state that he could find a considerable amount of capital to take up the work. It was necessary, to suit their policy, for the committee to treat this offer as rubbish; they quoted the opinions of several gentlemen to show that the estimate prepared by Mr. Ward was a rotten one; but Mr. Crompton, whom the board had called in, fully endorsed the conclusions arrived at, except to point out that the income would be considerably more than Mr. Ward reckoned, and that the return on the capital would therefore be higher. Mr. Hammond had placed a proposal before them which would receive every consideration; but it required going into with great care, and should not be decided upon off-hand at that meeting. (Hear, hear.)

Mr. Brown said the Chairman had thought fit to say that he signed the notice for that meeting without due consideration; the notice was signed in Mr. John Morris's office, and he (Mr. Brown) had Mr. Morris's signature with him. That gentleman, they would admit, was not likely to sign anything without consideration.

Mr. Peebles, chairman of the committee of investigation, in moving the adoption of the report, said the committee had sat almost daily since they were appointed on the 28th December. They had had an interview with Mr. Hammond, and were of opinion that he was negotiating most excellent terms—for himself. With regard to the Holborn order, he had occasionally met Sir Michael Kennedy, the late chairman of the company, and had said to him that the board would have to modify their ideas as to Holborn, and had asked him if they were prepared to sanction the expenditure of £1,500 to £1,700 there to supply a possible twelve householders. Having given the calculations by which he arrived at those figures, Mr. Peebles remarked that Mr. Ward had said that Holborn was the best area they had, and that he did not consider Chelsea a desirable area; and their investigations bore out those statements. It was an open secret that no electric station had yet been made to pay, and that few, if any, were self-supporting. The conclusion, therefore, was that the provisional orders were useless to this company. A circular issued by one of their active friends (Mr. Hammond), stated that the winding up of any of the remaining companies would be a great blow to electric lighting generally; but it was not their duty to enquire into that; the instructions to the committee were as to the further effect upon the pockets of shareholders. They could not advise them to adopt Mr. Borrer's suggestion, that they should go on for five or six years in the hope of some return at the end of that period, for they thought the shareholders had suffered quite sufficiently by losing £280,000 in that "novel enterprise," without losing another £25,000, or probably another £100,000, for if they once began no one knew where they would stop. Electric lighting was at present a failure, and the sooner the public were made aware of it, the better for their pockets. With respect to the overtures, again referred to by the board, Mr. Borrer gave

to them in secret the name of a certain firm, who mentioned the names of several eminent men in the City as being willing to support them; the committee thought it advisable that it should be ascertained whether the firm spoken of were entitled to make use of those names, but when Mr. Brown mentioned the matter to Mr. Borrer, the latter at once repudiated having used the names in that sense. The committee were all distinctly of opinion that he did so, and Mr. Brown even made a note of it at the time. The committee had now rescued the affairs of the company, and placed their control once more in the hands of the shareholders, and it was now for them to judge what further should be done. He begged to move the adoption of the committee's report.

Mr. Lawrence Engel seconded.

Several shareholders attempted to speak, but the uproar was so great, that but few could be heard.

Mr. Shippey was understood to offer, out of the wreck of the company, to show them "how to make some money." The directors had not carried out their duties, for they had had offers of business which they should have done, but which they were not able to do. The Brixton station, which cost this company a considerable sum of money, might have been made, with able management, to pay. Now, it was paying. He had sold it to some friends of his, and, where the Metropolitan Company had only two lamps running there were now 46. There was the finest field for electric lighting that could be imagined, not in ten years time, but in the immediate future, but no one company could carry out any system; everybody had got something, but nobody had got all. From the remainder of Mr. Shippey's remarks, which were frequently interrupted, it was gathered that he offered to buy the whole of the machinery of the company, "at any valuation," but he was ultimately compelled to resume his seat, and shortly afterwards withdrew, with the remark that they "might one day be glad to hear him."

Mr. Callendar said, after the meeting in August last he put himself in communication with a number of friends greatly interested in electric lighting, and afterwards, as the result of that, informed the directors of this company that he was prepared, on the part of influential gentlemen in London, to take up their work, to buy the concession and pay the money for it. When the difficulties with the committee arose, however, he at once told Mr. Borrer that his friends would have nothing to do with a company who were going into liquidation. This committee said they had certain things to sell, but they were so valueless that they would not touch them themselves.

Mr. Peebles: The committee have said no such thing, but they do object to having a red herring drawn across their path.

Mr. Callendar attempted to continue speaking, but the confusion was so great that he desisted and sat down.

Mr. Hammond, for whom loud calls had long been made, now made some lengthy remarks, and was listened to for a considerable time with great patience. He offered, in order that an amalgamation with the Hammond Company might be brought about, to give them £30,000 in six per cent. debentures in the Hammond Company, and another £30,000 in five per cent. deferred shares; or, to those who preferred, he would give cash on the basis of £30,000 for the whole concern. This offer was only to have effect in the event of the petition for liquidation not being proceeded with. After Mr. Hammond had been speaking for over a quarter of an hour,

Mr. Brown said it was a great question whether Mr. Hammond was not a promoter himself. With regard to his proposal, he offered them £30,000 in cash, or £30,000 in debentures and £30,000 in deferred shares. Their assets consisted of 20,000 sovereigns, £8,000 in plant and machinery, £6,000 in stock, and sundry debts amounting to £2,000 odd, altogether a sum of something like £30,000, without considering a single shilling expended on the provisional orders. He offered them paper in exchange for their sovereigns. (Demur.) In addition to what he had stated, they had the claim against the promoters. He did not say that it was possible that Mr. Hammond was himself a promoter without careful consideration, and no lawyer, knowing what he (Mr. Brown) did, would, without further investigation say that he was not. Mr. Hammond asked them to adjourn that meeting to consider his proposal, but it was not competent for them to deal with such a proposal, even if they did adjourn. He thought the true object of this proposal, thrown out, as it was, almost at the last moment, was not disclosed on the face of the circular, and he ventured to say that they would best consult their own interests by carrying out what the committee had recommended, and what the board themselves, in the circulars they had sent out, had recommended—that was, to pass the first two resolutions, to adopt the report of the committee, and resolve upon winding up. If Mr. Hammond, or anyone else, desired to take up the work of the company, there was nothing to prevent them from treating with the liquidators, and the orders were worth just as much under the winding-up as without. He could scarcely think that Mr. Hammond expected them to believe that what had been said already was going to become a dead letter if they adjourned the meeting. It had gone forth to the world in words which there was no mistaking that those provisional orders could not be worked at a profit in the hands of this company.

A Shareholder: What is our position with regard to the parent company?

Mr. Brown said there was a clause in the Brush license under which it became forfeited if this company went into liquidation. But what did they forfeit? Nothing at all. Would not the Brush Company sell them any number of machines, and allow them just as much discount if they did not hold the license? He could show them what an utter fraud and delusion the affair was from beginning to end. It was essential to wind up in order to get full information with reference to the promoters. When before the meeting on the last occasion, he was in the unfortunate position of having two opinions of counsel against his, but the subject had since been mentioned to one of the most eminent counsel at the Bar, who was in America with Lord Coleridge at the time of the last meeting, or he would have been consulted then, and his opinion was that the interposition of the City and Suburban Company put no bar whatever to their claim. As the best proof of the screw that was being put upon certain persons, he would state that within the last few days the chairman of the committee had received a communication from an intimate friend of one of the promoters, suggesting the desirability of coming to terms. (Applause.)

After some further discussion, the first resolution, that the report be adopted, was put and carried, with but about half-a-dozen dissentients.

Mr. Bell moved, "That, in the opinion of this meeting, it is desirable that the company should be wound up, and that the same be accordingly wound up voluntarily."

Mr. C. P. Whiteley seconded the motion, which was carried unanimously.

Admiral Inglefield moved "That Alexander Peebles, Admiral Sir Edward Augustus Inglefield, Lawrence Engel, John Hamlyn Borrer, and Charles Tottenham be, and they are hereby appointed to be liquidators of the company, with power to continue to carry on the business of the company in so far as they may consider requisite or necessary for utilising and realising to the best advantage the assets of the company, including the Provisional Orders." He mentioned, in doing so, that it was desirable that an amendment should be moved, substituting the name of Mr. Bell for that of Mr. Borrer and of Mr. Tottenham.

Mr. Brown, in seconding the resolution, pointed out that it was only *pro forma*, and proceeded to explain his position during the incidents of the past month or so.

Mr. Poole then moved the substitution of Mr. Bell for Messrs. Borrer and Tottenham, which was seconded, and carried unanimously.

Mr. Andreae moved "That the liquidators of the company be, and they are hereby authorised to take such proceedings as they may be advised in connection with the promotion and formation of the company and the purchase of the licenses, with full power to compromise, upon such terms as they may think fit, any such claim, or any other claim which they may, in the course of the winding up, be advised to make against any company, firm or person;" which was carried.

Mr. Engel moved "That the said liquidators are hereby authorised to transfer or sell all or any of the assets of the company to any other company, formed or to be formed, and to receive in compensation, or part compensation, for such transfer or sale, shares or other interest in any such other company, or to receive in compensation, or part compensation, for such transfer or sale, the right to participate in the profits of, or receive any other benefit from such purchasing company." This, also, was carried unanimously.

Mr. Brown moved that the remuneration of the liquidators be left to be fixed at a future general meeting, which was seconded by Mr. Poole, and agreed to.

Mr. Poole next moved the payment out of the funds of the company the expenses incurred by the committee in and about their investigation of the affairs of the company—between £300 and £400—and a remuneration of 400 guineas to the committee for their services.

Mr. Stuart seconded the motion, respecting the latter part of which, however, there was some demur; but upon a show of hands it was carried by a large majority.

Subsequent motions, which were carried without dissent, were to leave the course to be pursued with reference to the petition for winding up presented by the committee in the hands of the liquidators, and that notice of a further general meeting be sent out by the committee of shareholders, in such manner and when they might determine.

Mr. Poole moved a vote of thanks to the Chairman for the courtesy he had displayed during the meeting, and, this having been heartily accorded, was acknowledged by Mr. Borrer, who remarked that he wished the shareholders had been willing to hear more than one side of the question.

The meeting then terminated.

The Direct United States Cable Company, Limited.

THE thirteenth ordinary general meeting of this company was held at the Cannon Street Hotel, on Friday, the 8th inst., Mr. John Pender, M.P., presiding.

Mr. J. W. Fuller (secretary) having read the notice convening the meeting,

The Chairman stated that the revenue for the half-year, after deducting outpayments, amounted to £73,472 12s. 7d., and the working and other expenses were £21,824 4s. 5d., leaving a balance of £51,648 2s. 2d., as the net profit for the half year, making, with £1,852 7s. 11d. brought forward from the previous half-year, a total balance of £53,500 16s. 1d., which had been appropriated as follows:—An interim dividend of 5s. per share to the 30th September, 1883, £15,177 10s.; interim dividend of 5s. per share to 31st December, 1883, £15,177 10s.; set aside to reserve fund, £19,621 7s. 7d.; balance carried forward, £3,524 8s. 6d. The revenue showed a decrease of about £4,000 as compared with the

corresponding period of 1882, when the tariff was the same. This reduction was owing to the general depression of trade. The working expenses compared favourably with those of past half-years. On the whole of the expenses there was a reduction equal to about £2,000. The reserve fund had been increased by transfer from the revenue, and by interest on investments, to £340,000. Before asking them to approve the resolution he was going to propose—that the report and accounts be adopted—he wished to make a few remarks upon the past half year. Twelve months ago he put before them a very satisfactory statement in reviewing the position of submarine cables. Since that time there had been rumours of opposition, and of new cable companies being formed; but, looking to the fact that they had cables in the Atlantic—more particularly since they had been duplexed—far in excess of the traffic requirements, he had thought they would, for a time, have some repose. In this, he was sorry to say, he had been disappointed, and they would therefore naturally expect him to say something as to the coming opposition, and how far it was likely to affect their interests. When he learnt from unquestionable authority that Mr. Garrett and Mr. Bennett contemplated laying cables to work in connection with the Baltimore telegraph system, he believed both those gentlemen were perfectly able, from their position and the means at their command by being in that position, to do what they said. He had, however, knowing Mr. Garrett, given him, at his request, some information as to the probable returns, at the rates which they intended to charge, upon the capital they proposed to invest in the undertaking. He gave Mr. Bennett the same information, and he believed Mr. Mackay had had the opportunity of seeing the same document. Mr Garrett did not seem to be acting with the present combination, and he assumed, therefore, that Mr. Mackay had taken his place. Mr. Mackay was a man of very great wealth, very great energy, and he believed they would agree with him in saying, of very great courage, to put so much money at the bottom of the Atlantic. Mr. Bennett was equally enterprising; his name was probably as well known in London and Paris as in New York. He was the proprietor of the well known newspaper, the *New York Herald*, from which he derived a large income. Mr. Mackay stated that they had ordered two cables to be laid. He was called upon to make that statement on account of "sneering remarks in certain newspapers, which must have been put forward by professional promoters of companies, or by persons interested in existing cable companies." He wished Mr. Mackay to understand distinctly that, so far as the companies in which he (the speaker) was interested were concerned, they had never dreamt of sneering at him or his gigantic enterprise. He had a perfect right, however, to draw attention to a paragraph in his (Mr. Mackay's) letter to the *Times*, where he said his object in founding this new company was that he considered that "the time had come to give the public, on a permanent basis, a somewhat cheaper, and at the same time a thoroughly reliable and prompt, cable service." The natural inference to be drawn from that was that there was not at the present time existing a permanent, reliable, and prompt cable service. But what were the facts of the case? Regarding the existing cables, he believed the average time of transmission of all commercial messages was under twenty minutes, and a very large number were transmitted under five minutes; and during the last twelve months this company had only had one complaint of a message being delayed; that message was delayed but for one hour, in consequence of an interruption to their land lines, caused by a gale. They had eight cables, and it was impossible that any company having only two cables could successfully compete with them. As to the rate being too high, they had received no complaint from the telegraphic public, and the comparatively modest dividends they paid showed that the rates were not much more than sufficient to maintain an efficient service. They had tried the 1s. 6d. rate, the 1s. rate, and the 6d. rate, but at the lowest the increase in the number of messages was small compared with the enormous loss sustained. This showed clearly that the system was dependent on important commercial transactions, for which the element of efficiency and speed was of greater moment than the question of cost. The cables already in the Atlantic were equal to taking three times the amount of traffic offered to them, and placing further capital in cables would not tend to reduce the cost of telegrams to the public. It was therefore his opinion that Messrs. Bennett and Mackay's venture was not well timed in the public interest, nor could he see that it would lead to their own good. He strongly suspected, from the paragraph which preceded Mr. Mackay's letter in the *Times*, that Mr. Jay Gould had something to do with their action. There was, no doubt, a great deal of jealousy amongst those rich men in America, and perhaps Mr. Mackay desired to occupy a similar, if not a superior, position to that held by Mr. Jay Gould. Mr. Mackay said, "Owning the cable ourselves, and not being required to satisfy the wants of small shareholders, who, having but small capital at their disposal, are obliged to expect quick returns, and clamour for mercy for their 'one little ewe lamb,' we are in a position to take our stand, and defy all attempts at coercion." He (Mr. Pender) strongly suspected that, in the end, the "ewe-lambs" would beat them. They had in their company 1,353 shareholders, of whom 357 were ladies, and about the same number clergymen; there were many holders of two and three shares, while, leaving out one or two of the largest holders, the average holding was about 25 shares. He thought Mr. Mackay would agree with him that it was the duty of those connected with other telegraph companies to take care that the interests of their "ewe-lambs" were fairly protected, and he could not help observing that he might better employ his money than by entering their pastures and competing with a company who had been the pioneers of this great system to America. He had no hesitation in saying, looking to and studying carefully the future of this company, that the Direct Cable Company's position would be very little if at all injured by this competition. The rapid mode of communication by means of those grand steamers between Liverpool and New York tended to increase, both socially and commercially, the connections between the two countries, and it had become almost a necessity that the Press should do something more than they had hitherto done in regard to telegraphic enterprise. Mr. Mackay said he could pretty well employ his cable with Press messages. If he had gone into this enterprise simply for the purpose of becoming popular with the Press—because the Press of every country was a great power, and most men desired to be what was termed popular with the Press—if that were his object he had no fault to find with it. But he did not anticipate that the Press arrangement would do this company any serious amount of harm. An agreement existed between Mr. Bennett and the French company for the transmission of Press messages at 4½d per word, and he (the chairman) had been told by an American gentleman connected with the Press, that Mr. Mackay proposed to renew that agreement with the *New York Herald*, and even proposed to reduce the rate to 3d. per word. He had no doubt Messrs. Mackay and Bennett's cables would get a large share at that rate, but even if they absorbed it all, it would only enable this company to make more out of the fully-paid messages; and, after all, it was the commercial messages that made Atlantic cables pay a dividend. As to the remark of Mr. Mackay that he had no intention of making any agreement with the existing companies, he might say there was perfect harmony upon that point, and so confident were the directors of those companies that Atlantic telegraph cables had been overdone, that they would not in any way recognise any new cables; they had come to this determination in the broad belief that such cables were unnecessary, and not calculated to benefit either the promoters or the general public; and therefore they were prepared to leave the new company entirely to find its own level, which they had little hesitation would not be a high one. This (the Direct) company had £100,000 debentures falling due in October, and it was the present intention of the directors to pay off that £100,000 at maturity. They would take it from the reserve fund, saving £6,000 by doing so, and still have a reserve fund in proportion equal to any other cable company, whilst they would also have the power of increasing the reserve fund at any time. He concluded by moving the adoption of the report.

Mr. Ford seconded, and after a short discussion, in which much satisfaction with the policy of the directors was expressed by the shareholders, the resolution was carried unanimously.

The meeting was brought to a close with a cordial vote of thanks to the chairman.

Anglo-American Telegraph Company, Limited.

THE ordinary general half-yearly meeting of this company was held at the City Terminus Hotel on Friday. The Marquis of Tweeddale presided.

The Secretary having read the notice convening the meeting, the report which we have already published, was taken as read.

The Chairman, in moving the adoption of the report, said the revenue for the half-year, including the balance of £13,263 brought forward from the previous-half-year, had been £259,814, there being a decrease on the traffic receipts of £10,089, as compared with the corresponding period of 1882. He had no doubt that this decrease could be accounted for by the depression which existed in commercial and industrial circles. With regard to the proposed new cables which were to be laid in the Atlantic, considering that there were eight in existence already, and that theirs, being duplexed, therefore possessed double carrying capacity, and further that the traffic was, if anything, stationary, or slightly falling off, they would understand that the directors were surprised when they received the intimation that two more cables were about to be laid. It was still more surprising that gentlemen should be found to invest money to the extent of something like over £1,000,000 to secure that for which, as far as the directors could see, there was no necessity. As to the sum placed to the renewal fund, £75,000, the directors had given very careful consideration to the subject, and they were opposed to diminishing the amount. He moved the adoption of the report.

Sir D. Gooch, M.P., seconded the motion.

Mr. George Smith moved an amendment to the effect that the sum added to the renewal fund, instead of £75,000, should be £25,000, which he stated with the previous additions would make £100,000 for the past year; the renewal fund would then stand at £505,000, quite sufficient to cover the cost, he contended, of laying a new cable, should they require to do so.

Mr. Aston seconded the amendment, which was supported by a number of other shareholders.

The Chairman, in replying, at the close of the discussion, stated that the question of the amount to be appropriated to the renewal fund rested with the directors, who had thoroughly considered this matter. He suggested that the amendment, which, if passed, would have no effect, should be put as a recommendation to the board, that future additions to the fund should not exceed £100,000 a year. He could say nothing about the prospects of the new cables, or the intentions of those promoting them, but he did not believe the enterprise would get a full proportion of the traffic. With regard to the query of a shareholder, he did not think the time had yet arrived when they could definitely state

the total amount at which the directors thought the renewal fund should stand.

Mr. Smith agreed to the suggestion of the chairman with regard to his motion, and, the report having been adopted, it was put in the form of a resolution of recommendation, and carried.

Sir John Swinburne then submitted a resolution expressing the opinion that the working expenses should be reduced, but upon the representation of the chairman that as much as possible in that direction was already being done, it was withdrawn.

Sir Daniel Gooch and Mr. Francis A. Bevan, were re-elected directors, and the auditors, Messrs. Joshua Dean and Francis Glass, were also re-appointed, the meeting then dispersing.

The Phosphor-Bronze Company, Limited.

THE tenth annual general meeting of this company, was held at the offices 87, Sumner Street, Southwark, on Friday, the 8th inst., when the following report was submitted and adopted.

In referring to the accounts the directors have to state that the trade of the company during the past year, although greater in extent as regards sales than in any previous year, shows a relatively smaller profit. This result is attributable to various causes, among which is the fall at the end of the year in the value of copper and tin, thus making a proportionate reduction in the estimate of the company's stock. Should, as is probable, an advance take place in the prices of these metals, the benefit to the company in the enhanced value of its stock will be appreciable in the next balance sheet. It must not be overlooked that although this company retains the sole right under patents in this country of making phosphor-bronze alloys, there have been since their introduction many improvements effected in competing metals which are produced at prices at which it would be impossible to sell phosphor-bronze alloys with sufficient profit, and it is only reasonable to suppose that consumers and others, always anxious to economise, will try any new production which is offered at a cheaper rate than the old. Although in the face of so much competition and the desire for cheapness (based upon false notions of economy), phosphor-bronze alloys continue to hold their own and maintain their superiority against all competing metals, it has been found necessary to modify the prices for the company's productions in order to keep pace with the requirements of the day. Considering the general depression in trade, and the ruinous prices at which many engineering contracts are taken (precluding the use of the best materials), it must be a source of satisfaction to the shareholders to find their business still prosperous, with an increasing trade.

The rolling and wire mills of the company are now in full working order, and although during the past year (and particularly during the first six months) the expenses have exceeded the receipts, the orders for wire, sheet and rods which have lately been received, will go far to recoup the company for the preliminary outlay incurred. The trade in rolled and drawn phosphor-bronze and silicium-bronze now forms an important branch of the company's business, and must undoubtedly become more and more remunerative, as the goods find fresh applications and extended use.

Patents have been secured for Mr. Weiller's first invention and subsequent improvement in the manufacture of silicium-bronze in the following countries:—India, Canada, Cape Colony, Victoria, South Australia, New South Wales, Western Australia, Queensland, Tasmania, and New Zealand. The silicium-bronze telephone wire has already acquired the title of "the telephone wire of the day," and its sale is extending rapidly. The British post office, some of the Colonial telegraph administrations, and various railway companies, are making practical trials with silicium-bronze telegraph wire for overhead lines, and the general opinion among electricians is, that wires of this description will ultimately replace the cumbersome iron wires at present in use.

The directors recommend a dividend at the rate of 9 per cent. per annum, free of income tax, less the interim dividend of 5 per cent. paid in July. This will leave a small amount to carry forward on profit and loss account, which it would be desirable to write off the purchases account.

Mr. J. W. Bushby was re-elected to the board, and formally appointed manager in addition to his office as secretary.

The Cuba Submarine Telegraph Company. Limited.

THE twenty-fifth ordinary general meeting of this company was held at the offices, 61, Old Broad Street, on Wednesday, when Mr. De Mancha presided. There were but few shareholders present.

Mr. James Scott, the secretary, having read the notice convening the meeting,

The Chairman moved the adoption of the report, which we published last week. He said they would see that their earnings had been nearly £19,000, and after deducting the expenditure, there would be £9,194 to divide. This they proposed to apportion as follows:—£3,000 would go towards the preference shares, and the board purposed asking them to confirm the payment of a dividend at the rate of 7 per cent. per annum for the last half-year, free of income tax. They had had rather an anxious time during the last six months on account of the breaking of a cable, but they were very fortunate in having an engineer who was most zealous and intelligent, and carried out his work most effectively; in his last report he said that both cables were working in an admirable manner. He therefore hoped there was a brighter prospect for the next half-year than they had anticipated. The cost of repairs up to the 31st December, was £41,000; but since that work had been going on and was now completed, for which about £2,000 would come to the present half-year's accounts. Taking everything into consideration, he thought they might congratulate themselves on the state of their affairs. They had not yet been able to get the money due to them from the Spanish Government, but the king had given the order for it to be paid, and he hoped before long they would be in possession of it.

Mr. Low seconded the adoption of the report.

The Chairman, replying to questions by Mr. Cochrane, said as the last half-year was a very profitable one, and a great deal of work was done in the office, they thought it advisable to give a bonus to the employés at the head office; that was the reason of a slight increase in the London expenses. As to the £72 rent, they used to occupy a portion of the office of the government at Havannah, but, having been requested to remove, they were obliged to take offices for themselves. With regard to the question of competition, there was another line that could be used if any of their cables did not act, but up to the present time they had received no damage from it. On the contrary, comparing the number of messages this half-year, with the same period of 1882, there was an increase of 130.

The motion was then put, and carried unanimously.

The Chairman thereupon moved "that the following dividends for the half-year be now declared:—At the rate of 7 per cent. per annum, free of income tax, on the ordinary shares, and at the rate of 10 per cent. per annum, subject to income tax, on the preference shares."

This was seconded by Mr. Low and carried.

The Chairman spoke in highly complimentary terms of Mr. Keith, the engineer to the company, and Mr. Scott, the secretary, and, on the motion of Mr. Greenwood, a cordial vote of thanks was passed to those gentlemen.

A vote of thanks to the Chairman terminated the meeting.

United Telephone Company, Limited.

ON Tuesday afternoon an extraordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel, Cannon Street, Mr. James Brand presiding, for the purpose of considering and (if approved) of confirming as a special resolution in accordance with the statute the following resolution, which was passed at the extraordinary general meeting of the company held on the 22nd instant, that is to say:—

"That the Bill which is proposed to be introduced into Parliament in the ensuing Session, intituled 'A Bill to afford to the United Telephone Company (Limited) Additional Facilities for Telephonic Communication in the Metropolis, and for other purposes,' is approved, subject to such additions, alterations, and variations, as Parliament may think fit to make therein."

The Secretary (Mr. Thos. Blaikie) having read the notice convening the meeting,

The Chairman said—Gentlemen, I am very sorry to have to call you here again to-day; but we could not help ourselves. It is necessary by law. I had the pleasure of meeting you a fortnight ago, and I have now to move that this meeting confirms, as a special resolution, that set forth in the notice convening this meeting. I have no further observations to make to-day. I said what I had to say a fortnight ago, and I have now therefore only to ask you, if it is your pleasure——

Mr. J. W. Batten (one of the board): You will allow me to second the proposition.

The Chairman: Mr. Batten will second. We have enough proxies; but it is a purely formal meeting. If any gentleman likes to ask me any general question in connection with the company, I shall be glad to answer it.

A Shareholder: Is it competent to ask any general question at this meeting?

The Chairman: There is nothing against it in law, I think.

The Shareholder: I attended here to-day to ask what is the relation of this Company to the Consolidated Telephone Company? I understand there is an agreement of some kind.

The Chairman: The solicitor says you cannot ask such questions as this at this meeting, but I shall be glad to answer it afterwards.

The Shareholder: I only asked if it was competent.

The Chairman: I thought you wanted to ask something strictly relating to our United Telephone Company.

The resolution was then put and carried, and the proceedings ended.

The Dundee and District Telephonic Company, Limited.

THE following report was submitted to the annual general meeting of this company, held on Wednesday, the 6th inst.:—

The directors have pleasure in submitting to the shareholders the accounts and balance-sheet of the company for the year ending 31st December, 1883. The number of wires rented at the close of the year was 320, being an increase of 50 on the previous year. The net balance of revenue, after clearing off the balance of the preliminary expenses, amounts to £854 14s. 7d., which the directors recommend should be applied as follows:—To reserve fund (which will then amount to £600), £200; payment of a dividend, at the rate of 9s. per share, £450; total £650; leaving a balance of £204 14s. 7d. to be carried forward to next account, subject to such remuneration as may be voted to the directors.

It will be seen from the accounts that the amount expended in plant and stores is greatly in excess of the subscribed capital of the company. The directors therefore consider it necessary that the capital should be increased.

Provost Moncur, who presided at the meeting, moved the adoption of the report, and said the directors had been obliged a short time previously to lower their rates owing to the extraordinary action—he might say the unscrupulous action—of the National Company. That company, to dish the local company, first reduced their telephones from £20 to £5 each, but that ruse not being so successful as they could wish, they were now trying to undermine the local company by getting parties to sign an agreement like this—"The lessee hereby agrees to give up his connection with the Dundee and District Telephone Company, Limited, within six months from this date as a condition of entering into this contract." He characterised this conduct as unscrupulous. But, in spite of opposition, this company had not only maintained its ground, but had largely extended its operations and increased its usefulness. Moreover, the directors saw their way to recommend a dividend of 9s. per share, being 10 per cent., or at the rate of 5 per cent. per annum for the past two years.

Mr. Leng seconded the motion, and the report was adopted.

Mr. Jas. Murison moved that 50 guineas be put in the directors' hands as their remuneration for the past year.

Mr. D. Ireland seconded, and the motion was agreed to.

Mr. John Miln was re-elected auditor.

The retiring directors, the Provost and Mr. J. W. Shepherd, were re-elected, and Mr. Alex. Simpson was re-appointed general manager and secretary.

The National Telephone Company, Limited.—The directors have resolved to declare a dividend for the past six months at the rate of six per cent. per annum on the preference shares, and at the rate of one per cent. per annum on the ordinary shares, and that the balance of £3,942 0s. 5d. should be carried forward. The unaccrued revenue carried forward to the credit of the next account amounts to £24,146 7s. 5d. An extraordinary meeting of the shareholders has been called for Wednesday, the 20th inst., to authorise the issue of £75,000 in six per cent. first mortgage debenture bonds, of which it is proposed to issue at present £25,000 redeemable in five and seven years.

Hammond Electric Light and Power Supply Company, Limited.—With reference to the removal of Messrs. Hammond & Co., from 110, Cannon Street, to 117, Bishopsgate Street, we understand that the address of the Hammond Electric Light and Power Supply Company remains as heretofore, 110, Cannon Street.

Direct Spanish Telegraph.—The Falmouth-Bilbao cable being interrupted, arrangements have been made by which telegrams for Bilbao, Madrid, and other places in Spain can, during the interruption, be transmitted by the Eastern Telegraph Company's route.

The West Coast of America Telegraph Company, notify that the tariff for telegrams from Great Britain to Buenos Ayres and all stations in the Argentine Republic, *viâ* Galveston, is now reduced to 9s. per word.

Electric Sun Lamp and Power Company, Limited.—The offices of this company are removed to 6, Ridinghouse Street, Regent Street, W.

St. George Telephone Company, Limited.—Mr. Justice Chitty has fixed the 20th inst. for the appointment of an official liquidator of this company.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended 1st inst., amounted to £2,895; and for the week to the 8th inst., to £3,740.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 8th, 1884, were £2,823, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

PROCEEDINGS OF SOCIETIES.

Physical Society, February 9th, 1884.

Prof. R. B. CLIFTON, President, in the chair.

ANNUAL GENERAL MEETING.—The motion to make past presidents permanent vice-presidents was carried, and the articles of the society altered accordingly.

Prof. CLIFTON read a report on the business of the past year, which showed that steady work had been done by the society.

Dr. ATKINSON read the balance-sheet, showing a flourishing condition of the society. A proposal to adopt certain letters to indicate membership of the society when placed behind the name was, on the motion of Prof. G. FORBES, held in abeyance for the present. The officers and councils for the ensuing year were then elected, and were as follows:—

President—Prof. F. Guthrie, F.R.S. *Vice-Presidents*—Profs. R. B. Clifton, F.R.S.; W. E. Ayrton, F.R.S.; W. Chandler Roberts, F.R.S.; Dr. J. Hopkinson, F.R.S.; Lord Rayleigh, F.R.S. *Secretaries*—Prof. A. W. Reinold, M.A.; Mr. W. Baily, M.A. *Treasurer*—Dr. E. Atkinson. *Demonstrator*—Prof. F. Guthrie. *Other Members of Council*—Mr. Shelford Bidwell, M.A., L.C.B.; Mr. C. W. Cooke; Prof. F. Fuller; Mr. R. T. Glazebrook, F.R.S.; Mr. R. J. Lecky, F.R.A.S.; Prof. H. McLeod, F.R.S.; Dr. Hugo Müller, F.R.S.; Prof. J. Perry; Prof. S. P. Thompson. *Honorary Member*—Prof. H. A. Rowland.

Prof. CLIFTON then resigned the chair to Prof. Guthrie, whose zeal for the society he warmly praised. Prof. GUTHRIE expressed his high appreciation of the courtesy and kindness of the retiring president while in the chair. Mr. W. LANT CARPENTER proposed a vote of thanks to the Lords of the Committee of Council on Education. Mr. WHIPPLE moved the thanks of the meeting to Prof. Clifton. Mr. GRIFFITH and Prof. ADAMS proposed a vote of thanks to the Secretaries, Demonstrator, and Treasurer. Prof. G. C. FOSTER proposed a vote of thanks to the Auditors. The meeting was then resolved into an ordinary one, and the SECRETARY read a paper by Dr. O. J. LODGE and J. W. CLARK on the "phenomena exhibited by dusty air in the neighbourhood of strongly illuminated bodies." In 1870 Dr. Tyndall described the dark or dust-free plane rising from a hot body in illuminated dusty air. The authors discuss his and other explanations of the phenomena, and give reasons against them. They have observed that the plane is only a prolongation of a dust-free coat or layer of greater or less thickness round the body. They have experimented with the coat in various ways, detailed in the paper, but the general conclusion is that it is produced by (1) a molecular bombardment; (2) gravitation settling. It exists when the body is warmer than the air. The results are similar to those of Mr. Aitken, communicated to the Royal Society of Edinburgh. Prof. FORBES observed that Aitken shows that a room heated by a stove will have smokier walls than one heated by a fire, owing to the air being hotter than the walls. Prof. S. P. THOMPSON stated that he had found an electric discharge from a point in dusty air cause vortices in the air, the air shot off by the discharge sometimes eddying round again to the point.

NEW PATENTS—1884.

2814. "Electric governors." A. JAMIESON, S. ALLEY. Dated February 6. (*Complete.*)

2820. "Telephone receivers." G. H. BASSANO, A. E. SLATER, F. T. HOLLINS. Dated February 6.

2836. "Dynamo-electric machine." A. F. OPPERMANN, C. J. OPPERMANN. Dated February 6.

2858. "Means for producing and utilising electric currents in secondary circuits." L. GAULARD, J. D. GIBBS. Dated February 6.

2859. "Electric generating portable lamps." C. WHITFIELD. Dated February 6.

2873. "Galvanic batteries." J. GRAY. Dated February 7.

2931. "Electric gas-lighting apparatus, applicable in part to other uses." J. BLAKE, S. MOORHOUSE. Dated February 8.

2975. "Electrical tell-tale alarm apparatus for indicating whether an insufficient [or excessive amount of feed is being supplied to flour grinding mills, sifters, and other like machines." T. F. HIND, R. LUND. Dated February 8.

2988. "Means for indicating variations in electric currents or regulating electrical apparatus." T. J. HANDFORD. (Communicated by T. A. Edison). Dated February 8.

3034. "Apparatus for electrically controlling railway signals." C. HODGSON. Dated February 9.

3048. "Galvanic batteries." C. W. HARRISON. Dated February 9.

3098. "Signalling by electricity." E. B. BRIGHT. Dated February 11.

3106. "Apparatus for protecting electric circuits and instruments therein from injury by excessive charges produced by lightning or otherwise." H. H. LAKE. (Communicated by J. W. Dyer). Dated February 11. (*Complete.*)

3112. "Protectors for telegraph, telephone, and other electrical insulators." W. P. FISHER. Dated February 12.

3134. "Spring buffer and bracket for transmitting electricity from and to any number of engines, carriages, trucks, or vehicles in a train on railway or common roads." W. TOWELL, E. PLAYLE. Dated February 12. (*Complete.*)

3154. "Indicators for use with electric bells." W. W. HACKING. Dated February 12.

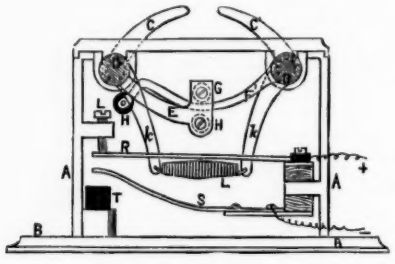
3159. "Insulating and protecting electric wires or conductors." W. R. LAKE. (Communicated by W. W. Averell). Dated February 12. (*Complete.*)

3173. "Coils or apparatus for the production of induced currents of electricity." L. GAULARD, J. D. GIBBS. Dated February 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

2575. "Apparatus to indicate the movements, &c., of trains, &c." E. C. WARBURTON and R. R. HARPER. Dated 23rd May. 8d. The object of this invention is to provide a safe and thoroughly reliable electrical contact maker in the form of a treadle, over which all kinds of railway and other rolling stock, either of a light or ponderous pounding character, may safely pass and effectuate without damage to such treadle, and at the same time without interference or damage to permanent way and rolling stock. It is also arranged so as to be free from weather interference, and the usually detrimental action of frost, snow, hail or rain either in its mechanical or electrical portions. The apparatus consists of an oblong iron box of suitable dimensions, and with a widely projecting base plate for stability of position when placed on the outside and close to the rail between two sleepers, the object being that the tread of the wheel and not its flange (in the case of railway rolling stock) shall by its superior breadth over the rail head, depress bent or segmental levers actuating electrical contact machinery on the passage of a wheel or wheels over them. Figs 1 and 2 show a sectional elevation of the treadle

FIG. 1.



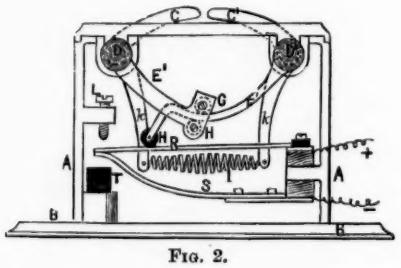


FIG. 2.

lever. C, C¹, are two bent outside levers, keyed or cast upon separate axles, D (level with each other), passing through the box at right angles to its longitude. Within the box, and keyed or cast on or near the middle of the same axles, are two bent irons, E¹, F¹, one of which is forked and provided with friction rollers, G, H, within the fork so as to permit entry and work in the same fork of the other iron, and so that the outer treadles may be actuated at one and the same time by transmitted action in whichever direction the wheel of a carriage, or engine, or roller may come. A spring or springs, I, J, placed in eyelet irons, K, between or on either side of these two bent irons or segments maintain the

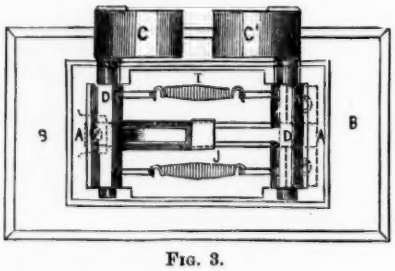


FIG. 3.

normal position of the outside treadles when not in use. Suitable adjustment stops or buffers, L, M, are provided to suit the several applications to this instrument. The friction roller, H, is insulated, or made of an insulating material, and makes contact by pressing down the spring, N, so that it slides on the terminal, P, but any suitable electrical contact may be actuated by the depression of the treadles. T, is a flexible buffer of insulating material, such as India-rubber, and an adjustment stop which may also be used for the conductor to earth.

2577. "Process for the metallizing and electro-gilding or plating of non-metallic substances, such as vulcanite, celluloid, and the like, specially adapted for dental purposes." C. G. HAMMERSLEY. (Communicated from abroad by F. J. Lynam, of Santiago.) Dated May 23. 4d. Relates to special solutions for the purpose.

2579. "Apparatus for electric lighting on railway trains, &c." W. STROUDLEY and E. J. HOUGHTON. Dated May 23. 6d. Relates mainly to improved means and apparatus for electric lighting on railway trains and other vehicles by means of dynamo-electric or magneto-electric machines and electric accumulators, reservoirs or secondary batteries, the dynamo-electric machines being driven by the motion of the train and thus made to charge the accumulators from which the electric lamps are supplied. According to one of the improvements the inventors effect the automatic reversal of the commutator brushes of the dynamo or magneto-electric machine on the reversal of the motion of the machine according as the train is travelling in one direction or the other, so that the collection and storing up of the current will be effected under all circumstances.

2592. "Telephonic apparatus for domestic use." G. E. GOURAUD. Dated May 24. 6d. Relates to new or improved apparatus to be employed chiefly in domestic telephonic systems. The primary feature in these apparatus consists of a peculiar switching device, but the invention also embraces other important details of construction, arrangement and combination.

2661. "Electric arc lamps." J. BROCKIE. Dated May 29. 6d. The first improvement consists of an appliance to retard the descent of the upper carbon holder, or the too sudden approach of the carbons in an electric lamp, trains of wheels, dash-pots, gravity or balance wheels, and such like, being hitherto used for that purpose. According to the invention, the inventor constructs and employs a hollow disc or cylinder having a weighted partition swung or pivotted on the axis of the said disc, so that if the disc is rotated on a horizontal axis, the partition will remain in a perpendicular position notwithstanding the rotation of the disc. He puts in that portion of the interior of the disc which is not occupied by the said partition, some glutinous substance, such as glycerine or oil; the disc or cylinder is then sealed as closely as possible, to prevent the leakage of the liquid. It will be seen that if such a cylinder be now mounted on a horizontal axis, and a weight or pressure less than that of the pendulous partition be applied to turn the disc, the rotation of the latter will be much hindered and slow, as the partition will keep the fluid in a practically fixed position, and therefore the substance will cause a friction or drag on the revolving interior surfaces of the disc, the amount of drag or hindrance depending to a great extent upon the nature of the said substance; the more glutinous or clinging, the greater the amount of hindrance.

2667. "Telephonic transmitting apparatus." J. GRAHAM Dated May 29. 6d. These improvements have for their object the production of a telephonic transmitter which shall be suitable for employment under the varying conditions of general use without such liability to derangement or necessity for delicacy of adjustment or manipulation requisite with those at present generally employed, whilst at the same time securing better results in speaking, simplicity of construction, and economy of manufacture. In carrying out his invention, the inventor provides a flat or a concave plate (such plate having a flat rim around it covered with india rubber, or other suitable substance, to serve as a cushion). This plate is retained in position against the inside of the case, and over a suitable hole or mouthpiece by springs fixed to the case, and pressing upon the said rim. Against this plate, and affixed thereto, is a piece of carbon or other suitable material adapted to hold or retain in position the end or ends of a carbon pencil or pencils or rods or pieces, the other end or ends thereof being supported by a metal or other suitable bracket capable of being adjusted by screwing or otherwise relatively to the carbon or other suitable piece. The pencil or pencils of carbon are retained in proper position by passing into suitable recesses in the said metal bracket or piece of carbon into projections passing therefrom into suitable recesses in the end or ends of the carbon pencil or pencils or other equivalent connection and the pencil or pencils or rods of carbon are supported inclined to the plane of the mouthpiece.

2670. "Dynamo-electric machines." W. HOCHHAUSEN. Dated May 29. 6d. The inventor makes an armature wheel of a large diameter, so that the necessary movement before the field cores can be obtained without unnecessary friction on the shaft. He also makes the armature of discs of metal such as copper cut into a series of zig-zags, the portions of the discs in which the currents are set up are radial, or nearly radial, strips, united two and two alternately at the outer and inner ends so as to form a closed circuit around the armature. A number of such plates are placed together with insulating material between them, and they are secured to each other by insulated rivets, and to a hub upon the armature shaft.

2673. "Galvanic batteries." A. M. CLARK. (Communicated from abroad by G. G. L. Velloni, of Paris.) Dated May 29. 6d. The cell consists of two carbon plates preferably of large dimensions attached to a supporting plate or cover of ebonite or other insulating material, and of an amalgamated zinc placed between them. This zinc is immersed in a porous vase or receptable of perforated caoutchouc of oval form, and is attached to an ebonite plate by clips or other means so as to be readily dismounted. This vase or receptable is filled with an exciting salt and the couple is immersed in a rectangular cell. This mode of construction enables the couple to be removed from the liquid during repose, and it is preferable when a number of elements are used to provide a winch for raising them all at once.

CORRESPONDENCE.

The Efficiency of the Heinrichs Dynamo Machine.

Mr. Heinrichs's statements regarding the above in your last issue call for one or two remarks from me in reply. Disregarding the questionable motives which Mr. Heinrichs is pleased to attribute to me, I proceed to answer the various points he has raised in his letter of last week. He says, "Your correspondent 'E,' when calculating the efficiency of my machine, selected from the above series a set of figures showing the largest current with consequently the lowest efficiency for the external circuit. He must have been aware that when he compared my machine with others of its own class, he was bound to select a set of tests where the current was nearly of the same quantity as in the other machines." Now permit me to point out that the comparison is not mine at all, but Mr. Heinrichs's. In the article referred to it is distinctly stated that the Heinrichs dynamo gives one light for each 5½ lbs. of copper, against one light for every 10 lbs. of copper in the Brush machine, and no mention is made of the comparative efficiencies of the machines, which is a matter of far greater importance. I repeat, such one-sided comparisons are *highly misleading*.

It is not my fault that the particular tests selected showed a low efficiency. These tests were taken when the machine was supplying current for lamps in the usual way. Mr. Heinrichs seems to think that a dynamo giving a large current must necessarily be a machine of low efficiency. This is not so. There is no reason why a dynamo giving a large current should not be as efficient as one wound for a small current. The current on which I based my calculation is presumably the current for which the machine was designed; at all events, it *is* the current on which Mr. Heinrichs bases his statement that the machine gives 50 watts per lb. of copper. Further, the set of tests on which I based my calculation was published in a scientific journal, and from their being there I imagine they were the particular results upon which experts were expected to base their estimates of the merits of the machine.

I am not aware that the fact of the Heinrichs dynamo having burnt six lamps in Paris modifies my argument one whit—although on that particular occasion I suspect the speed was nearer eighteen hundred than eight hundred—but in case Mr. Heinrichs should be inclined to further accuse me of unfairness, I will ask you to publish once more Mr. Kempe's tests, along with a table of my own, which will show Mr. Heinrichs once for all the true state of the case, and enable your readers to judge for themselves.

Mr. Kempe's table gives :—

Current C.	Electromotive force E.	External Resistance. R.	Internal Resistance. r.
36·4	143·3	2·1	1·83
33·7	149·3	2·6	,,
26·3	160·0	4·3	,,
17·7	161·6	7·3	,,
15·7	143·3	7·3	,,

Which, translated into another form, gives—

Current C.	Electromotive force E.	Watts C E.	Watts per lb. of copper. $\frac{C E}{90·5}$	Efficiency. $\frac{R}{R + r}$
36·4	143·3	5217	54·0	54 per cent.
33·7	149·3	5032	52·2	59 ,,
26·3	160·0	4208	43·6	70 ,,
17·7	161·6	2861	30·0	80 ,,
15·7	143·3	2250	23·3	80 ,, *

* Some Gramme machines I tested in 1882 showed an efficiency of 82 per cent. at 1,000 revolutions, with 10 ampères flowing through the circuit.

Your readers will see by the above table how the number of watts per lb. of copper falls as the efficiency rises, and how the machine, as I pointed out, "by the very fact of the large number of watts developed per lb. of copper is shown to have a low efficiency." Mr. Heinrichs can make out of the above facts what he pleases, but beyond a doubt, it is established from the tests which he published, that when his machine gives 52 watts per lb. of copper, the efficiency is only 60 per cent., and conversely when the efficiency rises to 80 per cent., the watts per lb. of copper are only 23·3.

I decline to discuss this matter further with Mr. Heinrichs. I consider I have fully justified my former remarks regarding the efficiency of his machine, and have shown conclusively that his two claims of high efficiency and a large number of watts per lb. of copper are mutually distinctive of each other.

To the more interesting part of Mr. Heinrichs's letter on the action of the Gramme ring, I shall probably reply next week.

E.

Bell's Telephone Patents in England.

In the REVIEW of 9th inst., there appears a letter from the solicitors of the United Telephone Company, in which they give the very important information "that the result of the litigation in the United States, respecting the Bell telephone, will not in the slightest degree affect the validity of the Bell patent in this country."

Who ever supposed that a decision in a foreign country on the validity of a patent granted there could affect the validity of a patent granted in Great Britain? Possibly these astute solicitors attribute the continual depreciation of the shares of their company to the existence of such a belief by the public, and hence their important communication. These solicitors proceed to inform the public that "the question of prior publication of the invention in this country was raised in the actions which have been tried both in England and Scotland, and the decisions of Mr. Justice Fry and Lord Maclaren upholding the patent have since been confirmed by the unanimous decision of the Court of Appeal."

I respectfully ask these solicitors, and also the many eminent counsel retained by the United Telephone Company, whether "the unanimous decision of the Court of Appeal" referred to is any guarantee that in any future suit which that company may bring for infringement of their patents, there may not be produced evidence, not known at the time of the trials of the actions referred to, which will establish prior publications, which will invalidate their patents? I am strongly inclined to believe that evidence is in existence, and can be produced, which will establish the fact that there was published in England, in 1869, the following description of a telephone receiver :—"An electro-magnet in front of a brass diaphragm, with an iron button attached to the centre of the diaphragm."

That original instrument is at present in the possession of a friend; and it talks as well as any Bell telephone.

I am also strongly inclined to believe that evidence is in existence that in 1865 a transmitter for telephonic purposes, consisting of a tension regulator in combination with a diaphragm, was made and publicly exhibited, by means of which "distinct articulation was heard in a receiver and the difference between the speakers' voices clearly recognised." This instrument is in existence and can be produced.

The validity of Bell's patent in the United States was upheld by three decisions of the U. S. District Courts. But, alas for the uncertainty of sublunary affairs, the late decision of the U. S. Circuit Court in Philadelphia virtually adjudged Bell's patent to be void, upon the evidence of hundreds of persons who saw and heard Drawbaugh's telephone instrument between 1867 and 1870, the fact being established that Bell was not the first inventor, as required by the U. S. Patent Laws.

May not a similar fate befall the Bell patents in Great Britain?

W. C. Barney.

Feb. 11th, 1884.

Electric Lighting by Batteries.

Could any of your subscribers give me a little practical information with regard to electric lighting by means of batteries.

I have bicromate cells, E.M.F. about two volts. Two carbons to one zinc (size same as No. 2, Leclanché).

For an economical result, in sustaining two incandescent lamps of 15 actual candle power, what resistance should the lamps have, how may cells should I use, and what would be the approximate up-keep?

Constant Subscriber.

The Theory of the Gramme Ring.*

The disinclination one feels to reply to an anonymous correspondent is not by any means lessened when that person characterises as "absurd and very misleading," the opinions of those who are so unfortunate as to disagree with him. I will, therefore, occupy as small a space as possible with one or two remarks on "E's" letter in your last issue.

As "E" asks me to explain how lines of force, "by cutting a second time the wires of one part of the ring neutralise on the inner side, the effect they would be capable of producing on the outer wires." I imagine he has neither read Antonie Breguet's "Machine de Gramme," nor the article on the "Theory of Dynamo-electric Generators" in "Electric Illumination." He will, I hope, excuse me if I refer him to those books for the explanations he requires.

In reply to the question, as to which will have the highest E.M.F., a machine having its greater dimension of the ring parallel to the spindle; or one in which the greater dimension is perpendicular to the spindle; the masses of iron, winding, &c., being alike in the two machines, I need only say, that the latter construction is the best; if for nothing else, for the reason that one effect of the encircling poles is to diminish the resistance of the magnetic circuit.

W. M. Mordey.

February 6th, 1884.

I was glad to see in your issue of the 2nd inst., a letter "E" (a *nom de plume* which, if I mistake not, conceals a name of high authority), in which he points out the fallacy of speaking of one portion of the circumference of a coil being active, while another portion is idle, or even developing an opposed E.M.F. (!) I think that these and other misconceptions arise from the habit of considering inductive action as resulting from the "cutting" of lines of force by the *wire*, instead of being due to the variation of the number of lines of force enclosed within the perimeter of the *coil*. Inductive action may take place without any lines of force passing across the wire, and conversely lines of force may be cut by the wire without producing an E.M.F.

The direction of the induced current, again, does not in any way depend upon which *side* of the circumference of the coil cuts the lines of force, but it depends upon which *face* of the coil the lines enter through.

Therefore, as (by the second law of thought), the number of lines of force enclosed by a coil, cannot be both increasing and decreasing at the same time, it is impossible that in different parts of the same turn of wire two opposed E.M.Fs. can be generated at one and the same time. Of course in different coils of the same *solenoid*, such an effect may be produced.

Such elementary considerations would not be so readily overlooked if it were borne in mind that this method of treating magneto-electric induction, arises from considering the voltaic circuit as replaced by its equivalent magnetic shell. And it has been shown that when the circuit encloses any loop, that portion may be treated (for this purpose), as a separate closed circuit, and replaced by its own equivalent magnetic shell.

W. H. Snell.

Liverpool, *February 5th*, 1884.

* See our "Notes" columns.—EDS. ELEC. REV.

The Action of the Telephone.

The recent communications from "Das Telephon" are very interesting, and tend to confirm the views expressed by me in some letters which you were good enough to publish in the spring of 1882, that the hard carbon microphone worked by make and break, and that an undulatory current, as described by "Bell," was not necessary to the reproduction of articulate speech by the telephone. I find that this latter view is rapidly gaining ground, and it would doubtless have been generally adopted long ago, but that the modern electrical professors, who had so often and so confidently explained the action of the telephone on the theory of the necessity of an undulatory current, did not see their way to a recantation. The simple fact is that Mr. Graham Bell exhibited an instrument that reproduced speech; he explained that it worked by what he described as his great discovery of an undulatory current, and his explanation was adopted without consideration or enquiry, and has since been used in the courts of law to maintain his claims as a discoverer. My own belief is that, under the laws of electricity, acoustics, and mechanical motion, all of which have to be considered in connection with the action of the diaphragm of the telephone, an undulatory current as described by "Bell," would not reproduce speech, though it might reproduce some sounds; and that an intermittent current, or current of sudden impulses, is all that is required.

If "Das Telephon" will connect the terminals of any ordinary transmitter by a resistance coil of about 100 ohms resistance, to act as a spark arrester, he will find the articulation much improved, and that the "minute arc" theory of the action of the microphone is disposed of.

In your last issue you publish part of a letter to the *Standard*, in which it is said that the recent proceedings in respect to the "Bell" patent in America will have no effect in this country; this is not so, for although some of the prior publications in America may not have reached this country before "Bell's" patent was applied for here, yet there is reason to believe that some of them did reach this country.

The extracts from the letter to the *Standard* further say, that the judgments of Lord McLaren and Mr. Justice Fry had been upheld by the Court of Appeal; this statement is only partially true, and is very misleading. The Court of Appeal decided that the exhibition of the Glasgow instrument was a publication of that instrument, which is consequently free to the public. The Court of Appeal further decided, as an examination of the judgments will show, that what is known now as the "Bell" receiver differed from the Glasgow instrument in some respects, and that the patent was good for the particular combination of parts of which that receiver is composed, which are:—

1st. A permanent magnet, which one of the judges said was adjustable;

2nd. A coil of wire on the end of the permanent magnet next to the diaphragm;

3rd. A diaphragm of iron or steel or metal capable of magnetic induction held down all round its circumference;

And this decision was only arrived at by "a benevolent construction" of the patent.

It has been generally considered, by people who have not looked into the question, that the judgment of the Court of Appeal upheld Bell's patent absolutely, and in its entirety; this is not so, and the judgments themselves should be studied by all who wish to bring new instruments into use, when they will at once see how much the Court of Appeal has limited the operation of Bell's patent.

There are many other questions arising out of the judgment of the Court of Appeal with which I will not at present trouble you.

H. B T. Strangways.

5, Pump Court, Temple, E.C.,
February 12th, 1884.